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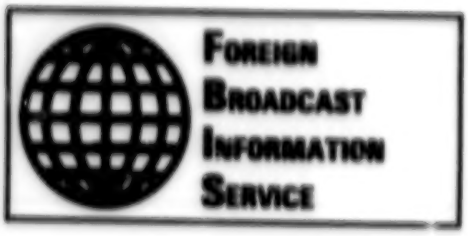

JPRS Report

Science & Technology

Central Eurasia: Space

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CONTENTS

Women Prepare for Four-Month Hypokinesia Experiment

947Q0091A Moscow KRASNAYA ZVEZDA in Russian 22 Feb 94 p 1

[Article by Valeriy Baberdin: "Space Recluses"; the first paragraph is an introduction]

[Text] Eight female test subjects have consented to a unique experiment: for 120 days they are to be exposed to hypokinetic conditions. In this way a long-term flight in an orbital complex will be simulated.

When I dropped by one of the hospitals in the Moscow area where the experiment is being carried out (its doctors asked not to be named), in my mind's eye I already had visualized a very smart picture—a group portrait on the first page of the newspaper, the smiling charming faces of young women. But it was not to be so. They point-blank refused to pose for us.

And this was understandable. We had dropped by without warning, like a bolt out of the blue, and moreover, at what for them was the end of a very hard work day. The fact is that the experiment itself for the time being is still ahead and at the present time the subjects are undergoing so-called background (like prelaunch) medical examinations—one had been spun around on a centrifuge today, one had been on a bicycle ergometer, another had been on the orthopedic table. Plus prophylactic examinations, analyses and consultations with specialists.

"When all these analyses, and consultations with specialists are over we'll lie down and then you can come and there will be time to talk and take pictures, the girls assured us. Indeed, this is training for an experiment and it is being organized by specialists of the Institute of Biomedical Problems and is proceeding as for a real space launch. And there is no less excitement. For one her teeth were bad and treatment was necessary."

Another problem: to preclude contact with outsiders (God forbid that an infection be brought in, then the entire 1 ½ years of work would be lost). The scientific director of the work, Boris Morukov, candidate of medical sciences, only recently was one of the standbys for the space physician Valeriy Polyakov. These investigations were nothing new for Boris. Something like this was done, but with males.

"The experiment is necessary for the future flight of Yelena Kondakova, who in the autumn is being sent to the Mir for a half-year," comments Morukov. "A woman in space is nothing new. There have been 20 in the United States alone. But our flight will be long term. It is necessary to take into account all the intricacies of the female body, female physiology."

The candidates for the tests were selected carefully, from all of Russia. The call was already sent out early last year. The competition was announced by television, by radio and in the press. The requirements were quite rigorous, with respect to medical requirements the same as for cosmonauts. Here are the names of the subjects: Olga Semenova, Sveta Retsina, Tatyana Turboyevskaya, Zhenya Chelnokova, Elena Berdyyeva, Zoya Zhiyentayeva, Galina Kirillova, Natasha Chidikova.

Among them there are specialists of the Biomedical Problems Institute and athlete trainers and a construction technician and an economist. The experimental conditions are not easy. All 120 days (!) in a row they are to lie there without getting up in a position with the head lower than the legs (it is necessary to ensure an intensified blood flow to the head, as in a state of weightlessness). The prophylactic tools used against hypokinesia are the same as on a space station: treadmill and bicycle ergometer. It will be necessary to employ these trainers in the same horizontal position.

I listen to what the physicians on duty are saying and look at the very complex equipment which will be used in the experiment and I am involuntarily filled with respect for the volunteer space recluses. Good luck to you, courageous subjects with great patience!

Post-Flight Interview With Cosmonaut Crew

947Q0095A Moscow KRASNAYA ZVEZDA in Russian 26 Feb 94 p 3

[Article by Valeriy Baberdin: "The 'Siriuses': We Were in Orbit With You"; the first paragraph is an introduction]

[Text] We already have reported that the "Siriuses," Vasiliy Tsibliyev and Aleksandr Serebrov, the cosmonauts recently returning from the Mir orbital complex, were guests in our editorial offices. They were accompanied by the crew's physician, Vladimir Krivolapov. They all participated in a regular creative editorial office meeting. They told of the problems of manned cosmonautics and shared their impressions about the flight. We bring the record of this conversation to the attention of our readers.

V. B.: Your orbital expedition has ended. Not counting the accident occurring during the last minutes of the flight (KRASNAYA ZVEZDA has told in considerable detail about the collision in one of its publications), in general the watch went off normally. But surely you remembered something most clearly of all?

V. Ts.: There is much which can be said about the flight. Especially for me, being in space for the first time. That from above the Earth looks exceptionally beautiful is something about which you have heard more than once. No photographic, motion picture or video survey can convey all the colors which are there. Leonov and Dzhanibekov in their drawings attempted to use paints in conveying the colors of space, also in vain. It is not by chance that the favorite pursuit of all who have been in orbit has been visual and instrumental observation.

The northern and southern lights and noctilucent clouds are amazing when viewed from space. Although there is the superstition: if you see them, expect bad luck. In actuality, so it happened. Prior to the tragic October events in Moscow strong northern and southern lights were observed and there were many noctilucent clouds. Yes, and a full moon to boot. "The very time for the activation of schizophrenia," joked Serebrov at that time. And he hit the nail on the head. Information was transmitted on the state of the Earth's atmosphere, formation of cyclones and different kinds of vortices: typhoons and snowstorms.

V. B.: That is something not reported in any newspaper. The unfavorable days with respect to magnetic storms are listed. But is information on natural catastrophes in the making not far more important for people?

V. Ts.: Unquestionably. And if you set yourself a goal, it is easily attained. From above it can be seen clearly when different kinds of troubles are beginning to brew in the atmosphere. In America, for example, when we discovered that a hurricane was in the formation stage, the Earth was warned by amateur radio (on the Mir there is a special antenna and equipment for this purpose). Two days later they confirmed to us that hurricanes in actuality were observed in the mentioned regions.

On Sakhalin it could be seen that vortical movements were developing. And in the Black Sea not far from Novorossiysk it was noted that a waterspout was forming. The information was transmitted to the locals. "Thank you, fellows," was heard in response, "but everything is like normal, things will be OK." But after a day... Unfortunately, there is no such service today which could collect all this information, analyze it, warn the population in time and take other necessary measures.

V. B.: Tell about the condition of the orbital complex. After all, it has now been in service for eight years.

V. Ts.: Yes, a very respectable age. And an ever-increasing amount of time is being spent on preventive maintenance and replacing assemblies whose useful life has elapsed. To be sure, the body of the station also is wearing out. A whole series of experiments was devoted to a study of its condition, including emergence into open space. For Serebrov it became the tenth, a record. The work also was given the name "Panorama." We carefully inspected the entire station skin and used a video camera in scanning its individual components.

It could be seen that the station has been well peppered by meteorites. Fortunately, there have been no through penetrations, but there are indentations, there are very many pits on the glass in the ports and elements of solar cells have been cut through.

With respect to preventive maintenance within the station, the work there has no limit. It's pretty sick to fly into orbit for glory, for an award; on the station you have got plenty to do. You have to get in there with the head and the hands. You have to work as a mechanic—with nuts, bolts and connecting pieces. Whereas under the schedule we were to go to bed at 2300 hours, in reality we laid down at 0100, or 0200, or 0300... It was necessary to think out things which were not covered in any shipboard instructions. For example, we were able to repair a spacesuit for emergence into open space and it had cost many, many millions of rubles.

But all that is but half the trouble. The most important thing now is that there is no money and the necessary equipment and instruments are lacking. The cargo ships arrive not fully loaded. First one thing could not be delivered, then another. The food aboard the station came to be in short supply. Not without reason did we slim down quite a bit during the expedition. Earlier there were milk products in abundance—then there was a problem. And remember, in space calcium is intensively excreted from the body.

V. B.: Is it possible that they could no longer find milk for the cosmonauts?

V. Ts.: Not just that. It turned out that boxes with canned meats on the Progress were empty or were packed with something else. If society is already sick, the sickness affects all aspects of its life.

V. B.: And nevertheless, when they asked you to remain in space for additional time you willingly agreed?

V. Ts.: It would be dishonest to say that it was entirely willingly. We simply appraised the situation and understood that there was no other recourse. Initially the program was to last for 147 days. It was assumed that it was necessary to remain in orbit for two or three weeks more. But it turned out to be two months. To be sure, psychological stress was involved and it had to be dealt with. And there was nothing which could be done about it.

V. B.: Speak frankly, during this time did you not become bored with one another? Did it not get on your nerves to be together in a restricted space?

V. Ts.: I tell you frankly and with complete responsibility that we had no such problems. And, indeed, there was no time to quarrel. Serebrov worked in one module and I in another. But we rushed to the table at dinner time like we were starving. On the other hand, we periodically made the effort to see one another.

The fact is that on the station in the space behind panels there are places where you can creep (under weightlessness conditions this is far easier to do), but from which you cannot extricate yourself without help. In addition, there are spaces not ventilated by fans. You get distracted by your work and carbon dioxide is released from your body, forming a stable spherical envelope around you. A person without realizing it first becomes intoxicated and then is poisoned by the gas and falls asleep.

V. B.: We've been talking about food, but tell us, for holidays did they not deliver an alcoholic beverage in tubes into orbit?

V. Ts.: Only if you tried to have it delivered.

V. B.: Did you try?

V. Ts.: And why does that interest you?

V. B.: Boris Serebrov. In your time you and Aleksandr Viktorenko were the first to test the SPK, the "space motorcycle," in action as a means for cosmonaut movement in open space. Since that time it's been forgotten. What happened to it?

A. S.: In general in a normal state it is placed in the locking chamber in a dismantled form. The machine is excellent, but there is no fuel—a special compressed gas—for it. When I arrived for training in the cosmonaut detachment, once again I tried out in the trainer to see if I had lost skill in controlling the "motorcycle." The exercise was not one of the easiest: with a weight of 50 kg on a hook, fly around the station. It turned out, quite the opposite, that my skill had improved.

Immediately I began to try to organize emergence with it into open space, a flight around the station. Indeed, using the SPK it would have been quite easy to perform well all the work under the "Panorama" program. Enter any zone, take photographs. Yes, and the Americans, I am sure, would be interested in it.

But here again the dealing has begun. Whose motorcycle is it? On the one hand, does it belong to the NPO Energiya, General Yuriy Semenov, or does it belong to the NPO Zvezda, Gay Severin? Each has its ambitions, its plans. Superposed on this is a struggle to save weight; it is necessary to carry along two gas-filled cylinders. Then it was found that someone had forgotten to order batteries...

V. B.: Tell us, during flight on the station were you not annoyed by UFOs?

A. S.: This time they caused no concern. But when Viktorenko and I tested the "motorcycle" in open space I recall that a healthy chunk of metal floated between us. Without identification marks. I understood that it was a UFO.

V. B.: Is it possible that there is so much trash in space?

A. S.: Far more than I would like. Even here mankind has laid its hand. But if all is thought through, even this problem can be solved, and quite simply.

V. Ts.: We were greatly annoyed not by UFO, but by identified objects—meteor showers. The fact is that in the first half of August there was a strong stream of meteorites. On the 12th of the month it was maximum, emanating from the constellation Perseus. During this period the Americans even postponed the flight of the next Shuttle. We organized an around-the-clock watch on the station. Serebrov and I actually did not sleep these days and observed the stream. Naturally, in the shadow, from which bursts are clearly visible.

This was an unpleasant picture. Especially when bolides (the largest meteorites) burst into the atmosphere. Their combustion time was 2.5-3.5 seconds, followed by an explosion. A total of more than 240 meteorites were counted. Those are the ones which could be seen. Later we learned that on the Earth the search and rescue service had been brought into full combat readiness. Helicopters and aircraft stood ready along the entire flight trajectory in the territory of Russia in the event of our forced emergency descent from orbit.

V. K.: They told us that several hours after returning to the surface, when your aircraft made a landing in your native Chkalov, without anyone's assistance you quite buoyantly descended the stairs. Then, after several days, you looked fresh at the traditional press conference. Giving an impression as if there had been no flight?

V. Ts.: This is more a question for the physicians. I will only tell you that preventive measures are important. We have acquired enormous experience in their organization during prolonged flights. It was acquired by blood and sweat. Physical training is the most important. We engaged in physical training twice a day for an hour, other than for days off and holidays. Plus special biomedical measures directly before descent from orbit.

V. B.: And if a cosmonaut becomes ill on the station? Let's say with appendicitis or a bad tooth. What can be done in such a case?

V. Ts.: A question precisely for our physician, Vladimir Krivolapov. Incidentally, journalists for some reason do not write about them, the crew physicians. But they are like our nurses.

From the very first day of preparation for flight as part of a crew they are responsible for our health. Prior to the launch and after landing the crew's physician is the principal intermediary for all our encounters and work with specialists.

V. K.: (crew physician). Treatment aboard a station is always a problem. To be sure, first of all we lay our hopes on the successful diagnosis and prediction of the condition of the cosmonaut's body. But after a half-year, and especially a year, anything can happen. At one time it was proposed that all spaceflight candidates have their appendix removed. But the other internal organs remain. The teeth are a very vulnerable place in man. It also is better that there be no teeth. I'm not joking—just that has been suggested, for example, with respect to cosmonauts flying to Mars.

With respect to the watch crew on the Mir, here we are counting more on the crew's capacity for keeping in good health. However, there was a case when because of this the flight was interrupted, when the sickness was treated

in orbit: physicians advised the crew from the Flight Control Center. Fortunately, there have been few such cases.

V. Ts.: But traumas, especially microtraumas, are easy to experience in orbit. In a state of weightlessness you do not feel weight. It's all the same if you lift a 10- or 200-kg part. But mass and inertia remain. Push a little too hard and you get pressed against a sharp edge. The force, indeed, under the law of mechanics is equal to the mass multiplied by velocity squared, divided by 2. We joked: it's good that it's divided by half, or it could kill you. Yes, they teach you to give yourself first aid and to give it to a colleague, but there's no substitute for a physician. I think that in the future a physician should mandatorily be a crew member.

V. B.: In orbit you perform an enormous amount of work, but down below, on the Earth, in the meanwhile, everything is collapsing. Here they shoot and kill and industry tumbles down before one's eyes. How do you perceive this psychologically in space? Does it not dishearten you?

A. S.: It's impossible to lump everything together. We have our work, our professional duty. Duty to ourselves, to those who work in the space industry, and finally, to Russia. And we strove to perform this work as well as possible, since after us there are others to come.

Yes, we were frankly indignant about what was going on in the country, but we were not disheartened. Each must be occupied with his own task. Ours was space technology, not politics. There is a good American saying. If you are driving an automobile with the left hand on the steering wheel and with the right embracing a girl, you do both of these poorly.

In our day, when it is impossible to foresee the morrow, when you cannot depend on the train or plane schedule for the next day, in the space branch we plan events many years ahead and they are carried off with the greatest accuracy. And this is noteworthy. I am sure that the country will extricate itself from its crisis. Russia always has been rich with Lomonosovs and Kulibins. It is only necessary to move on from political squabbling to business, with our hands and minds making specific things useful to all.

Use of Geodesic Satellites for Solving Basic and Applied Problems

947Q0100A Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 11, Nov 93 pp 8-12

[Article by V. V. Boykov, V. F. Galazin, Ye. V. Korablev; UDC 528.225:629.783]

[Abstract] In the 1970's and 1980's, the Main Directorate for Geodesy and Cartography set out to revamp the state geodesic network. That task has been helped considerably by satellite geodesy, which, over the past 25 years, has involved three main areas: the development and observation of passive satellites such as Pageos, Lageos, and Etalon; the development and observation of satellites such as Geo-IK; and the use of satellite navigation systems such as GLONASS and GPS. This paper examines the results of the use of the domestic Geo-IK satellites, which were used in 1977, 1985, and 1990 to ascertain the geodesic parameters of the Earth, i.e., the main astronomical and geodesic constants; the characteristics of the coordinate base; and planetary models of normal and anomalous gravitational fields of the Earth and local gravitational-field characteristics. The Geo-IK has been used in efforts to make the GLONASS- and GPS-system coordinates compatible. NPO Applied Mechanics is developing the new Geo-IK-2, whose capabilities will include accuracies to centimeters rather than meters. Figures 1.

State and Prospects of the Development of Space-Based Geodesic and Navigation Systems

947Q0100B Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 11, Nov 93 pp 12-17

[Article by V. F. Cheremisin, V. Ye. Kosenko, V. D. Zvonar, V. I. Yermolenko, Sh. Sh. Kavtarashvili; UDC 528.344:629.783]

[Abstract] Satellite geodesy holds decisive advantages over other forms of geodesy, e.g., coordinates can be transmitted thousands of kilometers very rapidly, and gravitational-field parameters can be ascertained with a relatively small number of ground stations. The accuracy of satellite measurements increased dramatically with the use of satellite altimetry. The Geo-IK satellite is the centerpiece of Russia's space-based geodesy program. It flies in a circular orbit with inclinations of 74° and 83°, with its longitudinal axis aimed at the center of the Earth. The service life of the satellite is less than a year, and one or two are always aloft. The satellite is equipped with a radio altimeter, an electronic interrogator system relay, a timing and signalling system, and laser corner reflectors. The next-generation Geo-IK-2 is under development. The Kosmos-192, a navigation satellite launched in 1967, was followed in 1979 by the Tsikada system. The successful use of low-orbit satellite navigation systems by maritime consumers has attracted attention to satellite navigation. A system that could be used by aviation, maritime vessels, ground-transportation systems, and spacecraft, however, would enable the user to ascertain three spatial coordinates instantaneously, velocity vector, and accurate time without an interrogator. The GLONASS high-orbital navigation system, consisting of 12 satellites in two orbital planes is serving well, but efforts are under way to make it and the GPS system compatible.

Experience in the Creation of Planetary Models of the Earth's Gravity Field With the Geo-IK

947Q0100C Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 11, Nov 93 pp 24-27

[Article by V. F. Galazin, Ye. L. Makedonskiy, A. N. Zuyeva, K. K. Nasretdinov, L. V. Medvedev, V. V. Orlov, I. P. Chugunov, P. E. Yakovenko; UDC 528.225: 629.783]

[Abstract] The Geo-IK satellites represent an important stage in the development of Russia's program for studying the Earth's gravitational field. They have been used to create planetary models in the form of harmonic coefficients of geopotential and in the form of a system of point masses. The harmonic coefficients of the GPZ-90 model (i.e., Earth's Gravitational Field for 1990) were determined with long-range radio, laser, and doppler measurements from ground stations; radio-altimeter measurements by Geo-IK; and measurement information from the ground complex for controlling the GLONASS navigation system; and average gravity anomalies for a 5° x 5° frame. The result was the GPZ.200 model, which enables determination of geoidal rise to with an rms error of about 1.5 m. References 3: 2 Russian, 1 Western.

Determination of Detailed Characteristics of Geopotential Over the World Ocean With the Geo-IK

947Q0100D Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 11, Nov 93 pp 27-31

[Article by V. F. Galazin, D. I. Pleshakov, S. V. Kryukov, S. F. Trifonov, P. V. Yarotskiy; UDC 528.225:629.783]

[Abstract] In recent years, a great deal of progress has been made in the development and refinement of new means and methods of space geodesy, one task of which involves the precision study of the fine structure of the geopotential over the World Ocean. Today, the primary method of performing that task is satellite altimetry. This paper examines the principal approaches to determining gravitational-field characteristics—i.e., geoidal rise and gravity anomalies over the water bodies of the World Ocean—and the results obtained with Geo-IK satellite altimetry information collected over the past five years. The main type of baseline data derives from some 18 million radio altimetry measurements. Two models are used to compute geoidal rise and gravity anomalies from those measurements: lunar-solar tides and maritime topographic surface. Geoidal-rise and gravity-anomaly catalogs based on Geos-3 and Seasat

data were used to check and analyze the results, as were gravimetric maps of the northeastern Pacific and the Sea of Okhotsk. Also used for that purpose were class IV maritime gravimetric surveys of the central Atlantic and average 1° x 1° gravity-anomaly values for the entire surface of the Earth. The measurements were processed in five stages: computation of geoidal rise; regional adjustment of altimeter tracks; processing of adjusted geoidal rises; global adjustment of geoidal rise; and computation of gravity anomalies from the geoidal rises. The gravity-anomaly catalog produced is among the most precise such catalogs published today for anomalies over the World Ocean. References 7: 5 Russian, 2 Western.

The Effects of Exposure to Factors Associated With Open Space on the Substructure and Optical Characteristics of Light-Absorbing Thermal-Regulating Coatings

947Q0101 Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA in Russian No 1, Jan 94 pp 55-63

[Article by L. S. Palatnik, V. P. Nikitskiy, I. Kh. Tartakovskaya, S. B. Ryabukha, V. A. Dudkin, V. F. Pusan, P. G. Cheremskoy, M. A. Borodkina, Kharkov Polytechnic Institute; UDC 535.511;32/34;536.24]

[Abstract] Samples with a porous, light-absorbing, inorganic coating based on low-vacuum condensates of aluminum were studied for the effects of a yearlong exposure to open space on the Mir station. A before-and-after study of the thermal radiation and spectral optical characteristics was performed with the FM-59, TRM-I, SF-26, and IKS-29 instruments with attachments for recording the mirror and diffuse components of reflection in the visible and IR ranges. Structural studies were done with optical and electron microscopy and low-angle x-ray scattering. For coatings that were 3 μm or more thick and were applied to both sides of a substrate, electron microscopy revealed that large, lengthwise pores about 1 μm wide were essentially intact after the yearlong exposure. The pores in the samples with fine coatings applied to only one side of a substrate, however, underwent structural changes in which the submicropores coalesced. Those coatings produced conditions favorable to processes controlled by surface diffusion. Exposure to open space raised the levels of reflection for the one-sided, thin coatings, and a substantial dimensional effect associated with coating thickness was observed on the radiation and thermal stability for the thin coatings. In general, diffusional changes in the substructure of the aluminum condensates were the primary source of degradation of the optical properties of the thin coatings. No appreciable changes were observed in the morphology of surface relief or optical characteristics in the thicker coatings. Figures 3, references 10 (Russian).

Work Proceeding on Spectrum-X-Gamma Astronomy Satellite Project

947Q0090A Moscow NEZAVISIMAYA GAZETA in Russian 1 Mar 94 p 6

[Article by Boris Konovalov: "Golden Mirrors Will Help in Seeing the Youth of the Universe"]

[Text] One of the principal achievements in cosmonautics was the birth of exoatmospheric astronomy. During the forty years of the space era this very ancient science has received more new information than during all the preceding centuries of development. The new Spectrum-X- Gamma Astronomy Project promises the world community the largest and most modern automatic exoatmospheric observatory for studying those radiations in the universe which cannot reach the surface due to the planetary atmospheric envelope. Today this project looks so attractive that 15 countries with the most different levels of scientific development—from the United States to Turkey—are participating in its implementation.

In order for it to be understood how important this exoatmospheric observatory will be for the world, we will state that such countries as Denmark, Finland and Israel are contributing to the instruments of the satellite to be developed sums relative to their gross national product which are comparable to those which Russia allocated for the entire space research program in 1993.

The total cost of the project for the Western participants alone is more than 150 million dollars. The satellite itself is being designed and fabricated in the well-known "space berth" of the NPO Lavochkin. The Space Research Institute, Russian Academy of Sciences, is in charge of coordination of all the work and its general scientific oversight.

The "heart" of the new exoatmospheric observatory is two X-ray telescopes—JET-X and SODART. The combined European (including Russia) JET-X telescope has the highest "keenness of vision" today. The SODART, a joint creation of Russia, Denmark and the United States, is a still larger instrument, 11 meters in length. It collects far more X-radiation and will make it possible to carry out more detailed research than was possible before. Working in tandem, these two telescopes will make it possible to make a new, highly important breakthrough in X-ray astronomy.

Better modern technologies were used in constructing these telescopes. Russia surprised the group of creators of the exoatmospheric observatory with the mechanical components and housing of the JET-X telescope. Its 5-m "tube," like the entire mechanical system, was supplied by the Central Scientific Research Institute for Special Machine Building in the Moscow area. The housing was made of carbon plastic, which is very light and strong and which virtually does not change its shape in a wide temperature range, which is very important for accuracy in the focusing of radiation. The British, for example,

did not believe that such a large housing of carbon plastic could be made sufficiently reliable. But after rigorous and completely thorough tests carried out in the famed Rutherford-Appleton laboratory doubts were replaced by delighted comments.

X-rays are attractive to researchers because the entire universe is transparent for them. They go right through it. But at the same time this also gives rise to serious difficulties. It is very difficult to fabricate focusing systems similar to ordinary optical mirrors. Although theoretically this also seemed possible.

It was found that X-ray radiation is beautifully reflected by mirrors covered by very thin (several layers of atoms) gold films. So that X-ray telescopes will be "golden" in the literal sense of the word. The SODARt will have 124 square meters of golden mirrors, fitted one into the other. But the gold itself was only one-tenth of a percent of the cost of fabricating these mirrors and bringing them up to the required quality.

The best modern technologies and materials were used for the observatory in order to obtain new information on the universe. One of the principal mysteries of the sky is quasars, already discovered in the 1960's, which emit like 100 trillion suns and "blink" with a characteristic period of about one month and whose size is comparable to that of our solar system. Thousands of quasars have already been studied. Most of them are at the edge of the universe observable by terrestrial instruments, that is, we see objects which are tens of times younger than the star world surrounding us. The X-ray telescopes of the new observatory can glance still farther and see the "birthplace" of the universe and register the birth of galaxies and quasars.

Today it is necessary to understand how these compact and powerful energy sources were formed and why in the past they were much larger. Indeed, now in the neighborhoods closest to us they have died out, like the dinosaurs, and have been transformed into "black holes," not sending any radiation outward. But since theoretically "black holes" cannot be destroyed, this means that these invisible objects should exist somewhere around us, concentrating in themselves a considerable part of the mass of the universe. Scientists must detect these "graveyards of black holes." In theory this is possible from the curvature of rays passing near such an invisible object and this is one of the tasks of modern science.

"The Spectrum-X-Gamma Project will be the first national Russian orbital observatory," I was told by Academician Rashid Syunyayev, scientific director of the project. "Every specialist in any scientific institution in Russia will be able to send in an application for research to be carried out and if the project committee deems it interesting, at no cost it will be allocated observation time from the Russian quota. Such a specialist has one obligation: the results must be processed and published within a year."

We will note still another feature of the project. After three years of flight the Russian observation quota will be opened for American scientists. But not without cost. For this NASA even prior to the launch must deliver to the Space Research Institute, Russian Academy of Sciences, a system for archival storage of data received from the satellite. It will be supplied with optical storage disks, robots and high-capacity computers giving rapid access to information for hundreds of users. It must be said that the archives must be organized extremely complexly. After all, approximately 8 gigabits of information will be received daily from the satellite, or to put in ordinary terms, about a million pages of text.

As was noted, the project should begin in late 1995. Russian space science is still retaining its very strong potential and if it is reasonable to use it, even with minimum support of the Russian government, it will be capable of carrying out first-class scientific projects attractive to the entire world community.

Details on KoronaS-I Solar Research Satellite

947Q0090B Moscow SEGODNYA in Russian 3 Mar 94 p 9

[Article by Veronika Romanenkova: "Orientation on the Sun. The 'KoronaS-I' Station Looks Steadily at the Star"]

[Text] An automatic universal station with orientation on the sun, the "KoronaS-I," was launched on the morning of 2 March from the Plesetsk cosmodrome by means of a Tsiklon booster. The implementation of the international project "KoronaS" (Complex Orbital Circumterrestrial Observations of Solar Activity), initiated yesterday, will make it possible to obtain new data on the star closest to the Earth. The sun is not only an energy source vitally important for earthlings, but also is the object responsible for magnetic storms causing malfunctions of equipment and even its complete breakdown.

The space vehicle will carry 12 sets of instruments, four of which exceed the world quality level. These include the Russian Terek telescope, the Defos, intended for research on global solar oscillations, the SKL for research on solar cosmic rays and the Sors solar microwave spectrometer.

The booster and vehicle were fabricated in the Ukraine. Poland, Bulgaria, the Czech Republic, Slovakia, France, the United States and Germany also participated in the project.

The participation of these countries in the project is attributable to the fact that Russia already for many years has studied the sun and has attained good results. But recently there has not been enough money to go around. And it has been advantageous for other countries to join with the USSR, saving considerable sums and entering the ranks of leaders in the solar research field.

The automatic orbital station, being situated alongside the sun, will make measurements whose implementation from the Earth is impossible. With its assistance it will be possible to make a more detailed study of the sun's internal structure, to investigate the phenomena transpiring on this star, and to ascertain the reason for the "escape" of jets of matter from the sun.

The guaranteed lifetime of the KoronaS-I is a year, but Professor Viktor Orayevskiy, doctor of physical and mathematical sciences, scientific director of the project, director of the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIR), Russian Academy of Sciences, hopes that the satellite will operate for six or seven years, to the next solar activity peak. The "KoronaS-I" will operate in a so-called quasisolar synchronous orbit. This means that for approximately 25 days the satellite will not "set" in the Earth's shadow but will "look" at the sun. Then a drift of the orbit will occur, the space vehicle will enter the shadow and after some time will return to its place.

Methods of Spacecraft, Space Debris Observation

947Q0117A Moscow DELOVOY MIR in Russian 14 Apr 94 p 8

[Article by Petr Gangnus, DELOVOY MIR special correspondent: "Space Archeology"]

[Text] Wars pass, archives burn, witnesses of events and their participants die, officials lose papers and the Earth's rulers change. And all that comes to be forgotten...

In any human activity, as soon as some unseen threshold is crossed, there is a need for a historical study of what has occurred as a result of one's own work. This is probably the threshold separating childhood from adulthood, when things have already accumulated in the past about which there is a need to ponder deeply.

If this version is correct, the space field became an adult in the 1980's. For twenty years before this everyone launched all kinds of objects. These launches were concealed from other parties. Some satellites exploded. Others were lost. And now all kinds of unknown objects are flying there above us... As a result a new science has been born and it can be called space archeology. Unfortunately, it is not concerned with traces of mysterious arrivals from the outside, but with our own objects.

When the first artificial earth satellite was launched it was known only approximately how it would fly. Right up to the end they were not sure that it would fly at all. The accuracy of observation of the satellite, to be sure, was still low.

But then telescopes appeared which were capable of tracking objects moving rapidly through the sky. It was far more difficult to determine exactly what was flying there. Any satellite in the strongest telescope is visible as a point—more or less bright. And from the changes in this brightness an effort is made to determine what it looks like. Up to the middle of the 1970's it was possible only to distinguish a sphere from a cylinder and a cylinder from a plane. An entire institute in Great Britain, breaking its head over this problem, deemed a more detailed solution to be unattainable.

But in 1981 the young Russian scientists A. Bagrov and M. Smirnov, working in the geodynamics section, Astronomical Council, USSR Academy of Sciences (now the INASAN), appeared on the scene. They were able to cut the Gordian knot: they began... to detect the sun's flashes. The fact of the matter is that the parts of the satellite send quite conspicuous blinks earthward. And by observing them it is possible to visualize from what parts this satellite consists.

When observing one ordinary satellite a very strange leaping blink was discovered. As if someone sent a flash from a hand mirror and it oscillated slightly. An ordinary satellite cannot produce such a picture. But it was announced as being specifically an ordinary communication satellite. But the blinks betrayed its secret: it was a scanning television system which shifted its "eye" to the right and left and accordingly the satellite oscillated and the sun flash jumped. The enemy was thereby exposed.

Another problem. A satellite is launched. We attempt to communicate with it, but no luck. There it is—it can be seen clearly, even with the naked eye. But it is silent. It is very possible that it is talking, but not to us. That is, its antenna is not turned in the right direction. Or the solar cells remained undeployed, for some reason or another could not be opened. And again the detection of the flashes makes it possible to ascertain the truth. Then it is possible to send a correcting signal from the Flight Control Center and the satellite will do that which it is told to do and everything will be in order.

What good are the blinks from a satellite? They can be seen clearly. When the light spot shines in the eye, the brightness of the object may increase a thousandfold. You can't hide that. Incidentally, if you saw in the sky that a moving star suddenly appeared, and then disappeared, you know: this is not a flying saucer, this is a simple sun flash. From a satellite.

In the late 1980's we learned to identify satellites even without the blinks. Using a computer. The author of these lines also was engaged in this work.

No method is a panacea. A satellite can be camouflaged. The very same M. Smirnov mentioned a combination of celestial bodies which it is difficult to identify. Visualize a small satellite to which a large, several times larger satellite, an inflated balloon, is coupled by a short tether. As much as you look at such a formation, as many calculations are made on computers, only the balloon can be distinguished.

But let's return to space archeology. It is necessary to determine the configuration not only of working satellites, but also the remnants of old ones. Some are continuing their orbital flight in the form of a grouping of individual parts. Others have exploded. And still others, crippled with time, fly on intact. And there are so many of them that sometimes it is difficult to observe the stars. The blinking of the fragments interferes.

A new term has appeared: space trash. We already have succeeded there, in space, in cluttering the place up. Some regions of near space are becoming dangerous for a large object, such as an orbital station. The velocity of a station is 7 km/s, but toward them move tiny fragments, sharp as nails, also moving at 7 km/s, a total of 14 km/s (for a bullet—800 m/s). No skin will hold up under that.

And how many different flying objects of all types are there in space? About 5 thousand intact vehicles alone. There are 15 thousand large pieces measuring more than 10 cm. There are more than 100 thousand pieces of an intermediate size (1-10 cm). And there are about a million small ones (1-10 mm). Intact vehicles are listed in catalogues and they are observed. It would be good to observe both the large and the intermediate fragments, but for the time being neither we nor the Americans have money for that.

Now these fragments are flying in small groups. There are, for example, even permanent groups over India and Ecuador. And if we know the shapes of these fragments we can determine how the pressure of sunlight acts on them and where the pieces will move in the future. M. Smirnov and his colleague A. Mikshin have encouraging words with respect to this problem: with time all these groups will break up, being uniformly distributed in all of near space, and then will fall to the surface. So that we can boldly clutter up the heavens in the future as well. It is true that with time it will be necessary for there to be a break in flights for some 30 thousand years, but on the other hand then everything will be cleaned up. And over the course of these 30 thousand years space archeology will flourish.

Hypersonic Propulsion Tests Support 'Orel' Aerospace Plane Project

947Q0109 Moscow NEZAVISIMAYA GAZETA in Russian 12 Apr 94 p 6

[Article by Dmitriy Borisov: "The Hypersonic Heart of 'Orel': Will the Space Planes Take Off?"]

[Text] According to foreign estimates, by the year 2000, the annual volume of the world space market will be about $400 billion. And commercial, economic, and science-related tasks are clearly on the rise, while purely military jobs are being cut back.

At present, all the space vehicles operating to meet the ground's needs—satellites, stations, modules—are being placed in orbit by expendable launch vehicles developed 30-40 years ago—the Soyuz, the Kosmos, and the Proton. Plans are also calling for their use in handling the tasks associated with the Federal Space Program for the period up to 2000-2005.

But what's next? The development of new launch systems requires 10-15 years. So the question has to be answered today. If another five years or so goes by, the gap between us and our competitors will become insurmountable.

So, based on worldwide statistics, the cost of using expendable launchers to place 1 kg of payload into a low Earth orbit 200 km high is $8,000-$10,000. The principal expenses are associated with the loss of the launch vehicle structure and with the use of expensive launch complexes that are serviced by a multitude of technicians. Moreover, the situation with the environment is becoming more acute, with the ground and space being polluted by the remnants of launch vehicles and unrecoverable space vehicles. And if the traffic between ground and space grows even more (in the world today, it's growing 5-7 percent a year), all those problems will snowball, requiring, among other things, a further buildup of the industrial production of expendable rockets.

There is only one way out—develop and build reusable space transportation systems for the purpose of cutting the cost of transporting cargoes by 5- to 10-fold and eliminating virtually all the drawbacks associated with expendable rockets.

The scientific-research and experiment work, Orel, which was begun in 1993 by the Russian Space Agency, is devoted to that very problem. In 1995, the report on the Orel must formulate the principal areas of development of Russian space transport.

A significant place in the Orel operations is held by engines. Of course, as test pilots used to say, even a toilet could fly if you put a motor on it. The head organizations for "motors" in the Orel project are the Central Institute of Aviation Engine Building (TsIAM) and the Scientific Research Institute of Thermal Processes.

TsIAM is studying what is perhaps the most "avant garde" of all of today's versions of space cabs. There, they are developing prototypes of engines for aerospace planes—vehicles that take off from an airstrip and ascend into space, using only atmospheric oxygen as the jet-engine oxidizer during their flight in the atmosphere, just as nonspace planes do. But the gas in the combustion chamber of such engines moves at supersonic speeds—four to five times faster than the speed of sound. And there's no turbocompressor that compresses that air—it shoots directly into the combustion chamber from the air intake. Hence the name of these engines—hypersonic ramjet, or scramjet.

In providing considerably better performance at high speeds of flight—speeds that are 6-16 times greater than the speed of sound—the scramjets also have their drawbacks: more precisely, they create certain problems for the designers. In order for a scramjet to start working, the airplane must first be accelerated by traditional turbocompressor or rocket engines, and, upon leaving the atmosphere, it must again switch engines—to rocket engines that do not need outside air.

Thus, an aerospace plane requires the use of a combined propulsion system that employs all of the best and the advanced in aviation-and rocket-engine-building. By comparison with an expendable launch vehicle, an aerospace plane lifting the same payload mass will have one-third to one-half the launch mass and will be able to take off and land at any time and at any place on the globe and will be able to enter orbit with any inclination.

Russia in the early part of the next century will witness the take off of its Tu-2000—a distant cousin of the supersonic Tu-144, a single-stage experimental aerospace plane, and a "pioneer" in the field of hypersonic aerospace transport.

TsIAM and 14 co-implementer/organizations are performing simultaneous design operations and tests of prototypes of engines—stand tests and flight tests. Near Moscow right now, in Turayev, renovation is about to be completed on the largest test stand in Europe for studying scramjets. New structural materials and software are being developed and put on line. Flight tests got under way in 1991.

It was a long road to the world's first flight of a scramjet vehicle—about 15 years. And the fact that the event finally took place is to the great credit of the officials and scientists at TsIAM and their colleagues from the experimental design bureau and the testing services.

At one of the rocket testing grounds in the vicinity of Lake Balkhash, the Kholod hypersonic flying laboratory—a fairly small axisymmetric scramjet with its own control system and hydrogen tank—was mounted the top of an Angara S-200 antiaircraft rocket. As the rocket gained the necessary speed—three to five times the speed of sound—it switched-on the engine, which initially operated with a subsonic stream in the combustion chamber and then switched to the scramjet mode. In the

second set of tests in November 1992, the engine operated with the gas in the combustion chamber flowing at a supersonic speed for 15 of 37 seconds of functioning.

Foreign specialists displayed a lively interest in the Baikhash tests. "The Russians are roughly two years ahead of the United States in the development of the scramjet," declared American expert David Bebb late last year. The French firms that joined the consortium HYPERSPACE paid 1 million French francs (nearly $180,000) for the right to participate in the second set of flight tests in 1992—in order to study the results that were produced. Using Russia's experience, Aerospatiale, Dassault, SEP, Onera, and Snekma are counting on saving considerably on the flight-related debugging of future vehicles.

And the fact is that in the context of the Orel program, the TsIAM people, together with the designers and producers, are ready to launch, by 1998, the winged flying laboratory IGLA (Russian abbreviation for "hypersonic research vehicle"), which will be capable of flying at a speed that is 14 times greater than the speed of sound. The building of such a hypersonic flying laboratory is expected to make use of a decommissioned ballistic missile and involved total spending over a five-year period of about 40 billion rubles, at the prices for the first quarter of this year. By comparison, when the Americans allocate $60 million this year for their X-30, that is generally considered simply a civilized form of closing the program.

International cooperation is a special issue. The Chinese and the Germans, the Americans and the French—all of them want to fly "the Russian way." To test promising systems on the unique Turayev stands. To get data from the flight experiments. But the most important thing still is to deal with the "domestic" problems involving future space launchers and high-level technologies. To get our bearings with the wings of Orel.

NPO Molniya Designer Urges Hydrocarbon-Fueled Aerospace Plane Project

937Q0191 Moscow ROSSIYA in Russian No 9, 24 Feb-01 Mar 93 p 11

[Article by Vitaliy Natalich, Chief Designer of NPO Molniya]

[Text] The general trend in the improvement of space vehicles is evident—to create aerospace systems which use more economical winged flying vehicles for putting into space payloads on the order of 5 tons.

Among the more promising projects for multipurpose, reusable aerospace planes—MAKS "VTB+OS," "Interim-Khotol," and "Khotol M."—those which have the best chances for realization are the ones which answer the set of requirements for a more complete fulfillment of power-engineering specifications.

The projects for aerospace planes envision the use of liquid hydrogen as fuel, and this substantially limits the possibilities of their use for a number of reasons, but particularly because of their low parameters of reliability and safety. The general lack of experience in operating aerospace systems on liquid hydrogen fuel casts doubt on the axiomatic assertions about the high priority of the systems. The technical director and supporter of the use of hydrogen fuel naturally can boldly construct the simplest fuel tank in the world, and one which is also the most complicated in its aerodynamic aspect and technical utilization. But imagine to yourself the psychological state of the crew of a MAKS or an AN-225-"Interim-Khotol" system which is carrying on board a "hydrogen bomb," ready to explode with the slightest leak in the tank of liquid hydrogen. It is a known fact that in the case of mixture with air, detonation takes place in a wide range (from 4 to 75%) of hydrogen concentration.

However the need for reliable and inexpensive space vehicles remains urgent.

A group of specialists, who have substantiated the possibility of creating practical space aviation, have developed an alternative project for an aerospace plane—"Promethues," which operates on hydrocarbon fuel. It most fully achieves power engineering specifications, thus essentially differing from the planes mentioned above. In calculating ballistics, strength, engine characteristics, and other features, the generally accepted methods were used and assumptions were based on real and statistical data, taking into account the technical level which has been attained to date.

A comprehensive analysis of various concepts on aerospace planes according to other questions demonstrated that, as compared to flying vehicles using hydrogen fuel, aerospace planes on hydrocarbon fuel, which have minimal mass and dimensions as a result of the high density of the fuel, when combined with the lighter artificial earth satellites of the new generation are preferable for the near future, since they are superior in terms of all criteria without exception—economic, technical, commercial, operational, technological, efficiency of use, reliability and safety, building time, etc.

It should not be forgotten that attempts to use hydrogen fuel in aviation have proved to be ill-founded. A calculation of technical economic indicators (in the prices of 1990) confirms that, at present the world prices for putting into orbit a unit of mass of a commercial payload, the expenditure for the development of an aerospace system with aerospace planes on hydrocarbon fuel at a rate of 40 launches a year will pay for itself within two years. With improvement of operational qualities and an increase in the number of launches to 80 per year a profit of $ 13.8 billion can be expected over a five-year period.

The saving in funds as compared to the carrier-rocket Soyuz in combination with the space vehicle Progress amounts to 15.3 billion rubles. In this context one carrier-plane and four aerospace planes can put into orbit a payload which is the equivalent of the payloads of 800 Soyuz carrier-rockets with Progress space vehicles.

In addition to this, aerospace systems with aerospace planes using hydrocarbon fuel make it possible to economize on metal, fuel, alienated lands, and other resources, which are becoming ever more expensive.

The delay in starting the development of aerospace systems, while financing non-priority activities and launches of carrier-rockets with Progress space vehicles, is bringing irretrievable yearly losses of 0.6 billion rubles, or 1.6 million rubles per day.

The changes which have taken place make it necessary basically to reformulate Russia's policy on the use of circumterrestrial space, and to determine the most important directions for research efforts in this area.

In this context it is necessary to take the following facts into account:

1. The production of a considerable number of carrier-rockets, (whose volume will correspond to the previously planned program for space activities of the USSR for the period 1996-2010), with analogous aerospace planes and payloads will be the task of enterprises in the Ukraine.

2. The The Baykonur Space-Launch Complex, which provided for a significant portion of the launches of carrier-rockets of the USSR, is now located in a foreign country.

3. The economic situation which is taking shape in the Russian Federation is forcing a reduction of financing for space programs, yet at the same time it is necessary to save the aerospace industry from complete destruction and to provide employment for the many factories which are connected with space.

In these circumstances the proposed concept for aerospace systems offers the only realistic prospect for the develolpment of practical astronautics for Russia in the near future,—and to be specific:

1. Production facilities for an aerospace system are located within the territory of the Russian Federation.
2. In the territory of Russia there is a sufficient number of the airdromes necessary for basing aerospace systems.
3. In Russia the infrastructure (production facilities, test base, etc.) which is necessary for the production of liquid-propellant rocket engines on hydrocarbon fuel, aerospace planes, equipment, etc., has already been created.
4. Russia posseses trained cadres which have invaluable practical experience in the development, production, and operation of this type of technology.
5. The main features of the proposed aerospace system are based on a level of technology which has already been attained in Russia.
6. There is a backlog of uncompleted work in the creation of reusable orbital spacecraft, in the development of new construction materials and of more perfected hydrocarbon fuels, with improved power and operational charcteristics.
7. As compared to other concepts, the builidng times, amount of necessary financing, and technical risk are minimal.

To generalize what we have discussed above, we shall note that with competent leadership in the field and the correct allocation of funds (both state and private) Russia has a unique opportunity to take up a leading position in the field of inexpensive and reliable space vehicles for the delivery of payloads into circumterrestrial orbit, and to capitalize on this position in the form of concrete political and economic gain.

NPO Energomash General Designer Interviewed

937Q0193 Moscow TRUD in Russian 1 Sep 93 p 3

[TRUD's correspondent interviews Boris Ivanovich Katorgin, General Designer of the science-production association "Energomash"]

[Text] **Katorgin**: A few days ago I discovered in the works of Academician M. V. Keldysh an acknowledgement, which today is of very topical interest: "Only due to the creation in our country of powerful rocket engines has it been possible to move forward at a fast tempo towards the conquest of space." One would like to learn more about a science-production association, an organization which was headed for many years consecutively by V. P. Glushko.

The story of our science-production association begins on 15 May 1929, when a group was formed in the Leningrad Gas Dynamics Laboratory to develop rocket engines. In 1934 this group became part of what became the first jet propulsion scientific research institute in the world, and in 1941 it was reorganized into an experimental design office. During the past 60 years this organization and its staff have undergone all kinds of changes, but the subject of its work has remained unchanged—liquid-propellant rocket engines.

TRUD: Please tell us, even if only briefly, the most important landmarks in the development of the organization.

Katorgin: The first liquid-propellant rocket engine to be produced in this country was the ORM-1 engine, which was developed in 1930-1931 in the Gas Dynamcis Laboratory, and which devoloped a thrust of about 20 kg and a pressure in its combustion chamber of several atmospheres. As the design of the engine was being perfected it went through more than 70 modifications, right up until the appearnce of model ORM-65, which was suitable for manned flight. This engine was built in 1936.

When at the end of the war V.P. Glushko on the instructions of Stalin acquainted himself with the engines of the V-2 rocket in Germany, his experimental design office had already created a series of rocket engines into whose designs at that time had been incorporated all the basic principles of liquid-propellant engines in their contemporary form.

Those who today try to minimize the significance of the scientific achievement of Academician V. P. Glushko tend to forget that the decision after the war to launch the production of engines for the V-2 in the Soviet Union was inspired by completely different (although in their own way important) aims—to gain experience in the organization of such a complex and for those times unique type of production, to prepare the material base which was required for it, to forge cooperation, etc.

Valentin Petrovich at the same time solved another, no less important problem. It was demonstrated and proven that any attempts to "squeeze out" of the engines of the V-2 any appreciable reserves of power, reliability, etc., had no prospect of success.

Today we can say with legitimate pride that in the engines for the Sputnik and Vostok rockets, which put the first artificial earth satellite and the first man, Yuriy Gagarin, into space, were realized those same principles and solutions which were laid down and developed experimentally by V. P. Glushko and his pupils on their own, and indepedently from the Germans. These principles and solutions were also in many ways different from those of the Germans.

TRUD: You mentioned an engine of the next generation?

Katorgin: Yes, I mentioned the first liquid-propellant engine of powerful thrust which uses oxygen-kerosene fuel, and which was developed in the years 1954-1957 for the first stage of the carrier Vostok. In connection with it the RD-108 is usually mentioned, also a four-chamber engine, which uses the same fuel, is based on

the same design and technological principles, and which made up the second stage of the rocket in question. Both of these engines and their modifications up until the present time have been in operation as part of the assortment of space carrier-rockets which are are making it possible to carry out the the Russian Program for Manned Flights.....

TRUD: Were there any other landmark events in the life of your science-production association?

Katorgin: Naturally! I would mention, for example, the creation of the RD-253 for the carrier-rocket Proton, the first stage of which is made up of six engines of this type. This is the most powerful existing single-chamber liquid-propellant engine, and operates on high-boiling fuel components. And take note of this: Since 1969 this engine has been operating without malfunction in the first stages of the carrier Proton, providing flights for space vehicles on assignments relating to the national economy, as well as launches of interplanetary space stations and space vehicles towards the Moon, Venus, and Mars. It has also put into circumterrestrial orbits the long-term manned space stations Salyut and Mir. And today this engine surpasses foreign analogs in its characteristics, and has good prospects for many years to come.

And finally the third important stage in the creative work of the science-production association was the development, production, and putting into service of the RD-170 engine, which is recognized throughout the world as unique in its power and its design solutions. Without exaggeration it is an engine of the 21st century, and is attracting the close attention of many foreign companies who are working in the field of rocket engine building. It is a four-chamber liquid-propellant engine which posseses the highest parameters and power charactertics for rockets of its class.

We are convinced that the use of the engine in question, which has no analogs in the world with respect to its combination of characteristics, will open up wide possibilities for the creation of continuously functioning orbital complexes on circumterrestrial orbits and for the actual realization of manned flights to Mars.

TRUD: It is quite clear that making such a significant journey into unexplored realms, at times under such extreme conditions, as did Valentin Petrovich and his comrades at the end of the thirties and the beginning of the forties, could only have been accomplished by a collective of like-minded people.

Katorgin: This is indeed true! One of the unique qualities of Valentin Petrovich as a director lay in the fact that at all stages of the work of the science-production associaiton he knew how to unite "under the banner" of his ideas a pleiad of outstanding designers, engineers, and scientists. And, incidently, this applied also to talented craftsmen and simple workers, who in no way yielded place to the legendary Levsha.....* It was specifically this approach to the solution of personnel problems which today gives our asscociation a high degree of viability, even at a time of "great shocks" in our economy.

Valentin Petrovich possessed an amazing integrity of character, as well as devotion to a single great idea, which he strove to achieve under any circumstances, even to the limit of human capacities. He was without a doubt not only a pioneer, but also a great enthusiast for space. His life, as well as his thoughts and actions were all related to space. All the rocket engines which he created bear the stamp of his will and his talent.

TRUD: What high-priority project is your science-production association aiming at today?

Katorgin: The presently available test base of the association, which is fitted out with up-to-date equipment, can be used for conducting comprehensive tests of various kinds of products under conditions which have been made as close as possible to operational ones. This refinement, if you will, is a kind of invitation to potential partners and to collaboration.

You will be surprised to learn that our interests nowadays go beyond the limits of activities which are traditional for science-production associations.

I will note for a start that space is rapidly being turned into an arena of international cooperation, and is becoming a realm of politics on a grand scale. At the center of attention for world business today are projects for a global telecommunications system, a system which would be suitable for inclusion into the world system of communications based in space which is being built up today.

Analysis shows that Russia today, in spite of the extreme seriousness of the general situation in our economy, has at its dispoisal all the necessary elements for its own independent organization of a system of satellite communications and for entering into competition on the world market in this field.

In order to organize such activities in space, in the interests of the Russian people sensible federal programs are necessary, which would (particularly in the intiial stage of the work) be provided not simply with declared, but with real and active support from the government. Unfortunately no unifying and mobilizing initiative on the part of government agencies in this field, which is so important for Russia, can be perceived. And time is passing.

TRUD: Speaking of the future, do you consider a further incrrease in the power of the rocket engines built by the association as an urgent task?

Katorgin: I believe that the capacity and power engineering of the liquid-propellant rocket engines which are being built for today are completely sufficient for answering the requirements of humanity within the foreseeable historical perspective.

TRUD: If it is not a secret, what do you dream of today ?

Katorgin: Why should there be any secret here? I would like to believe that all we Russians recognize that in the future we simply cannot live without space. Without a recognition of this truth we cannot continue to move ahead with confidence in the conquest of space.

The enormous experience which we have accumulated in the creation of powerful liquid-propellant engines and our possession of unique technologies creates a favorable basis for fruitful international cooperation. Our science-production association is open to contacts and cooperation. And we shall welcome any steps in this direction.

[*Translator's note: Levsha (Lefty) is the main character in a well-known story by the Russian writer Nikolay Leskov (1831-1895)—"The Tale of the Cross-Eyed, Left-Handed Craftsman of Tula and the Steel Flea."

In the story (briefly outlined) Tsar Alexander I after the end of the Napoleonic War makes a state visit to England. England was then the most technologically advanced country in Europe, and the tsar during his visit is taken on tours of English factories of various kinds. The tsar, in a tradition begun by Peter the Great, is very much of a "Westernizer"—(that is he tends to admire everything European and to disparage everything Russian). Accordingly he is very impressed with everything he sees, as are all the members of his staff—all with the exception of a Cossack officer, one Platov, who is in the habit of saying: "Yes, that's very good, but our Russian craftsmen can do just as well or better." Before his return to Russia the tsar is given a gift by a group of English steel manufacturers,—a life-sized steel flea, which, when wound up with a very small key, can hop about and move its feelers.

The tsar returns to Russia and forgets about the flea. Some years later (in 1825) he dies, and is succeeded by his brother Nicholas I. Nicholas, (who is less of a Westernizer than Alexander), finds the flea, summons Platov, and asks him if he can't find a Russian craftsman who can copy it, or at least make something as good.

Platov takes the flea and departs. After some weeks he returns with Levsha (Lefty), a cross-eyed, left-handed craftsman of Tula (a town famous for its metal workers). Platov tells the tsar that Levsha has improved the flea. On inspecting it the tsar can see no change from the flea's previous condition, except that, although it can still move its feelers, it can't seem to hop about as nimbly as before. On Levsha's suggestion the tsar examines it under a microscope. He now sees what the "improvement" has been: Levsha has shod the flea with tiny golden horse-shoes.]

U.S., West Europe Said To Block Russia's Access to Space Profits

947Q0092A Moscow EKONOMIKA I ZHIZN in Russian No 4, Dec 93 p 15

[Article by L. Kamanin "Is Access to Outsiders Allowed?; Our How We are Entering the World Space Market" the first paragraph is an introduction]

[Text] The critical state of the national space industry is approaching a limit beyond which its resurrection in the years immediately ahead may become impossible. In striving to avert the impending catastrophe, the Russian Space Agency (RSA) is imparting maximum efforts for the commercialization of all space activity in the country and to enter the world market. Recent publications in the foreign press give eloquent testimony of the "successes" attained by the RSA in this field.

To start off I will cite an article by J. M. Lenorovitz, senior international editor of AVIATION WEEK AND SPACE TECHNOLOGY, included in a special number of this journal in the Russian language under the highly promising title "Russian Commercial Launches Not Far Off."

"The United States has defined the conditions for entry of Russia into the world market for commercial launches of boosters and has notified West European representatives of the need for concessions in the direction of development of free competition. The fact that an American-Russian agreement was signed ... has caused dissatisfaction among representatives of the American aerospace industry..."

This same article states that one Dana Rohrabacher, a Republican from California, tried to console the representatives of the leaders of aerospace companies, declaring that it was necessary "to perceive the appearance of a competitor in the form of Russia to be a result of the collapse of the Soviet Union, long awaited by the United States."

Just what are the conditions causing the dissatisfaction of American entrepreneurs, who for some reason or another have "forgotten" the principal precept of the businessman: "Whatever you do in this world you have to pay for it?"

Under the adopted agreement Russia up to the end of 2000 can conclude not more than one contract annually for the launch of geostationary satellites by Russian carriers and contracts for the launch of low-orbit satellites must be specially examined in each individual case; the "bilateral agreement applies to all satellites put into space regardless of where they were constructed and by what countries they will be operated." Businessmen in the United States have exhibited a touching concern about the income of Russia: the amount of payment for each commercial launch of the Proton carrier must not be less than 92.5% of the price asked for similar launches by American or West European companies.

Moreover, the congressmen and representatives of the American administration are not without success playing the role of good Samaritans, as if defending Russian interests against the encroachments of evil West European commercial interests. The latter, it goes without saying, are not delighted with the attempts of "Russian agents" to intrude themselves into the "trade ranks" of the world space market. But American businessmen, in turn, are anxious about the considerable fraction of Western Europe in profits from commercial

launches of satellites despite their own relatively small (35%) share. That is why they, relying on the protectionist policy of the American government, are striving to dictate their rigid requirements on the concluding of trade deals with both new and well-known competitors. As declared by an assistant of the U.S. Trade Representative, Peter Allgeier, ... the representatives of Western Europe are trying to load the agreement, defining such (fettering for Russia and other potential competitors—L. K.) rules, with simplification of the procedure for their obtaining sanctions by the American government for carrying out launches.

What kind of profits can we count on in the event that the bilateral agreement enters into force within the framework of the restrictions set by them?

Yuriy Koptev, general director of the Russian Space Agency (RSA), declares with assurance that participation of boosters in commercial launches and the sale of rocket-space technology will annually bring Russia not less than 200-220 million American dollars. However, we take into account that in 1992 the total world profits from the commercial use of space technology attained 13.2 billion dollars; the income from the use of boosters did not exceed 1.2 billion, that is, 9% of the total sum. This means that the country which was the first to blaze the trail into space will be allowed to receive for making its boosters available to other countries not more than 1/60th of the total world "space profits." So that, pardon me for saying so, is the net result of commercialization...

And then there's another "space ultimatum" which the American administration directed to the Russian government in connection with the contract concluded in 1991 between the USSR Glavkosmos and the Indian Space Agency on the delivery of cryogenic engines to India. For the freezing of the two-million dollar contract with India we were handed a "bird in the bush": increased chances for Russia to participate in construction of the Freedom orbital station were promised.

President Clinton, on the basis of expert evaluations, has set a limit of 10.5 billion dollars on the financial expenditures for constructing the Freedom station up to the end of the 20th century, either independently or in collaboration with Western Europe and Russia.

As already reported in the press, the Russian prime minister Vladimir Chernomyrdin, in setting off for negotiations in the United States, declared that the participation of Russia in implementation of the Freedom project would enable the Americans to come out ahead by more than two billion dollars. But what would we receive? The directors of the Russian Space Agency declare that for the assistance which Russia will give the United States in constructing the station they will pay us 600-700 million dollars. We note: in the event of adoption of a joint trilateral project a good half of the station modules will be units developed for our future Mir-2 station and the American laboratory will be occupied with not more than a quarter of the total volume of construction.

Why, you may ask, do we place such a low value on our work, our scientific and technical achievements? After all, the minimum cost of the American "quarter-share" of the future station is estimated by American specialists at 10.5 billion dollars, whereas the Russian "half," if our prime minister is to be believed, is only the 2 billion saved by the Americans due to use of units from the Mir-2 station. And why can we, if the RSA is to be believed, receive only a third of this obviously understated sum?

From everything said above a conclusion follows which is as evident as it is disconsoling for us: neither our West European space partners, nor the Americans, are burning with desire to have still another competitor in the space technologies and services market. And therefore our penetration into the world space market conforms to the Russian proverb: "he went for the wool and returned with the clippings."

Editor's note. The author of the article has touched on the most important aspects of the entry of Russia into the world space market. We are sure that there also are other opinions on this subject. Accordingly, we invite all interested readers to continue the initiated discussion.

Present Status of 'Polet' Production Association in Omsk

947Q0093A Moscow KRASNAYA ZVEZDA in Russian 5 Mar 94 p 4

[Article by Aleksandr Manushkin: "They Pledge Their Hearts to 'Polet'..."]

[Text] Earlier it was forbidden even to mention this enterprise in the press. The Omsk Polet Production Association, participating in creating the rocket-space shield of the country, was off limits for the press. Upon the ending of the cold war, with the warming of the international climate, the entire world learned about the association.

From the "K3" dossier. The enterprise was established in 1941 on the basis of aircraft plants evacuated from Moscow and the Moscow region. In a few months the workers had to master standard production of the Tu-2 dive bomber. Over the course of 2 ½ years 3405 Tu-2, Yak-7 and Yak-9 military aircraft were constructed. During the postwar period the production of the Il-28 jet bomber was organized and 758 aircraft were produced.

The association also has priority in producing the world's first jet passenger aircraft, the Tu-104, of which 58 were constructed.

Beginning in the 1960's, under conditions of the strictest secrecy, Polet workers made "items" for use in space. It has to its credit more than forty international cooperation programs within the framework of the Intercosmos and COSPAS-SARSAT organizations. The two-stage Cosmos liquid-fuel booster, still constructed at the association, has put hundreds of Russian and international

satellites into orbit. The Polet Association also has priority in constructing Energiya assemblies and engines.

The twenty thousand workers of the NPO Polet, like the entire country, are now experiencing tough times. The enterprise has found itself in a very tight "vice" as a result of conversion, which was not fully thought through, the collapse of economic relationships among the former union republics and a shortage of financial resources. But here they not only do not complain of difficulties and problems, but also are searching for ways out of the crisis. The most important thing, in the opinion of the leadership of the association, headed by Valentin Zaytsev, its general director, is to preserve the scientific production potential of the Polet aerospace corporation and its unique production. The association is breaking its way through to the world aerospace market and is concluding contracts with many foreign organizations. In order to maintain a high production level, to conserve the skeleton of the design bureau and the entire work force, it was necessary, to be sure, also to engage in the organization of "incidental" production: automatic lines for the food and petroleum industry, machine building, medical equipment and instruments, washing machines and other household appliances.

To be sure, not everything has withstood the hard times. Some of the people for different reasons have left the work force. But most of the people have remained. Over the course of 50 or more years of its existence entire generations have grown up and a definite structure of social arrangements and amenities has taken shape. In short, although it is now difficult for many, one must go on. After all, the hearts of these people are attached to the Polet Association; many have passed their entire life here. The people believe that the Polet Association has a future.

Prospects for Upgrading Capacities of Plesetsk Cosmodrome

947Q0098 Moscow ROSSIYSKAYA GAZETA in Russian 6 Mar 94 p 4

[Article with no byline: "Russia's New Space Capital"]

[Text] Before the year 2000, Plesetsk (in Arkhangelsk Oblast), where no heavy-lift launchers or manned spacecraft have ever lifted off, could become the cosmodrome from which all types of domestic space systems are launched. That's according to the chief of the Main Center for Testing and Use of Space Systems (the Plesetsk Cosmodrome), Maj. Gen. Anatoliy Ovchinnikov.

The official date of birth of Plesetsk—initially a defense facility where the R-7 intercontinental missiles stood in combat readiness and were aimed at the United States and were, during the Caribbean crisis, on red alert—is 1957, when the wave with the first landing force arrived there. In 1964, the decision was made to re-orient the missile complexes of Plesetsk to the peaceful purposes associated with space.

Today, from the nine launch pads of the northern spaceport, four types of launchers lift off (the Soyuz, the Molniya, the Tsiklon, and the Kosmos), and they place in orbit nine types of science- or national-economy-related satellites (the Bion, the Resurs, the Foton, the Molniya, the Meteor, the Okean, the Musson, the AUOS, and the Nadezhda). Military satellites are also launched from Plesetsk. Over Plesetsk's nearly 30 years of history, two accidents have occurred (in 1973 and 1980), taking nine and 51 human lives.

Because of the indecision between Russia and Kazakhstan on the question of the fate of the Baykonur cosmodrome, the role of Plesetsk has recently begun to grow. Even if Baykonur is leased from Kazakhstan, Russia will still need a base for launching heavy-lift vehicles and manned spacecraft. That is especially important for performing the Russian-American program Mir-Shuttle and the international project for the creation of the orbital station Alpha.

In the opinion of Anatoliy Ovchinnikov, Plesetsk is best suited for solving those problems. True, the location of the cosmodrome—far from the equator, which requires more power to put some space vehicles into orbit—does present something of a problem, but one that can be solved. But the Arkhangelsk taiga and tundra—a sparsely populated area—is convenient as an area into which spent rocket stages can fall. In addition, radiation field effects are minimal here, which is important for the integrity of biological experiments.

In Plesetsk, the cosmodrome chief says, there wouldn't be any need to perform new construction—some of the facilities would just have to be reoutfitted, and the living area would have to be renovated. That would take about 5 billion rubles at 1992 prices, three of which has been promised by the President of Russia. But the biggest problem for Plesetsk, in the words of Anatoliy Ovchinnikov, is the lack of specialists and the assembly of launch-support teams. In fact, the drain of personnel has virtually come to a halt, and many of those serving at Baykonur now are getting ready to move to Plesetsk.

ICBM Base at Svobodnyy To Be Converted to Cosmodrome

947Q0096A Moscow ROSSIYSKAYA GAZETA in Russian 12 Mar 94 p 1

[Article by Semen Ivanov and Veronika Romanenkova, ITAR-TASS correspondents: "There Will Be a Cosmodrome in the Taiga"]

[Text] By the year 2000 Russia will have still another cosmodrome in the Far East, designated by the interim name "Vostochnyy," in the neighborhood of Svobodnyy. In contrast to Plesetsk, from the new cosmodrome it will be possible to launch boosters of the heavy Proton class, but they will be ecologically clean variants. This was stated in an interview to an ITAR-TASS correspondent by Colonel-General Vladimir Ivanov, commander of the Russian military space forces.

The end of the "cold war" and the disarmament which is now taking place has brought to the brink of extinction the once most powerful type of armed forces, the Strategic Rocket Forces, which this year marks its 35th anniversary. Under the conditions of the agreement on the reduction of strategic offensive weapons (START II) signed by the presidents of Russia and the United States at Sochi on 3 January 1993, the two great powers are continuing the disarmament process, thereby reducing the confrontation to a lower level.

Under the agreement, before the year 2003 all surface intercontinental ballistic missiles (ICBM) in Russia will be liquidated, including the heavy RS-20 (SS-18), in the United States also called the Satan, which beyond the ocean had caused the greatest anxiety. As a result of implementation of these agreements among the seven types of ICBMs only one type will remain in Russia—the RS-12M (SS-25), both mobile and stationary. The first missiles to be destroyed will be those developed and constructed at an earlier time—the RS-16 (SS-11), RS-12 (SS-13) and RS-16 (SS-17). In order not to leave the impression that there is a unilateral disarmament of Russia, it also must be noted that American ICBMs also will be destroyed or reoutfitted.

By the beginning of 21st century some of the 20 Russian regions of deployment of the offensive missile complexes of the Strategic Rocket Forces now in existence will cease to be. These will include first of all the Vershet (Perm Oblast), Drovyanaya and Yasnaya (Chita Oblast), Kostroma, Krasnoyarsk and Svobodnyy (Amur Oblast) regions.

Until recently Svobodnyy remained the most eastern region of deployment. The armament there consisted of the RS-10 ICBM, aimed at the United States. This single-warhead 17-m missile with a launching weight of more than 50 tons carried a nuclear charge of 1.1 megaton, which is 50 times greater than the power of the bomb dropped at Hiroshima by the United States in 1945.

So it happened that a wise government decision to reoutfit a defense facility at Plesetsk into a space facility was made almost 30 years ago—in 1964. Now, after all the years have passed, a similar decision has been made with respect to reductions of the rocket division at Svobodnyy, which was going under the knife. As a result, the Svobodnyy facility will be retained, but it will play a different role—as the Main Center for Testing and Use of Space Equipment (TsIPKS).

A little more than two weeks remain to the meeting of the presidents of Russia and Kazakhstan, planned for the end of March, which in many respects can and must be important. Because the documents signed as a result of this meeting—especially with respect to the Baykonur cosmodrome (contract and agreement), as well as with respect to military-technical cooperation, should determine the future relations of the two countries in these fields up to the beginning of the 21st century.

The interests of the defense capability and safety of Russia cannot and must not in any way be made dependent on the policy of another state, even if it is a friendly state which is part of the CIS. Precisely this has dictated the striving of Russia to have its own cosmodrome; Svobodnyy was selected as the final location (initially three possible variants were examined). A well-built residential city of rocket forces, a hospital and other infrastructure facilities costing several hundreds of millions of rubles, which now, it seems, is to receive a "second wind," are already here and the rocket forces, performing their military duties, will launch boosters and spacecraft into space.

It is proposed that two launch facilities for heavy boosters of the Proton type, but new, ecologically clean variants, will be constructed in the neighborhood of Svobodnyy.

Unfortunately, the short-sighted position of the Russian Space Agency (RSA), not fully taking the interests of Russia into account, precluded the participation of Plesetsk in implementing the project for constructing the Alpha international orbital station. This position scarcely can be justified by the "youth" of the RSA, recently marking its second anniversary. After all, the governmental males standing at the "space helm" have gone through the real "Momovskaya school" (Ministry of General Machine Building [MOM]). Nevertheless, the Alpha project approved by them is completely oriented on Baykonur. But under the conditions of nonfinalization of the negotiations with Kazakhstan with respect to Baykonur, complicated by the on-again off-again approach of that independent state, the international project will be considerably more difficult to implement from the purely political point of view.

Therefore, in order for Russia to carry out an independent space policy and to ensure guaranteed access to space Russia has been forced, using the existing infrastructure, to proceed to the reoutfitting and construction of a new cosmodrome in the Far East where more than three thousand rocket troops now serve.

Opposing Views on Russian Space Cooperation With U.S.

Russia Seen in Subordinated Role

947Q0097A Moscow ROSSIYSKAYA GAZETA in Russian 16 Mar 94 p 3

[Article by Vladimir Yaropolov, doctor of technical sciences, under main headline of "Space Ark. Who's At the Helm?": "Of the Competitors, We're the Assistants..."; first paragraph is source introduction before Yaropolov's piece]

[Text] **The negotiations between Russia and the United States on cooperation in space may wind up with a decision to create a joint orbital space station. That aim evokes differing assessments from specialists.**

The capabilities and infrastructure of the domestic space sector could be destroyed if Russia accepts NASA's proposal with regard to an international space station project. The development of the Alpha station, mainly with U.S. equipment and in cooperation with Europe, Japan, and Canada, could reduce us—with two modules and a transport craft—to a "second-string player." But it is Russia who is creating a space infrastructure for the United States, and that 3-3.5 years earlier than they had planned to do it on their own. But their attempts, which have cost them almost $10 billion, have not been successful.

The future station, built and serviced with the American space shuttles, can fly with an orbital inclination of 57°, and maybe even 51°. Consequently, it will not fly over all of Russia, as had been planned for our Mir-2 station. Recall that Mir-2 was supposed to lift off in 1997, to an orbit of 65°, which would make it possible to continue remote sensing of the ground. The Alpha enables survey of no more than 5 percent of our country.

The United States will have the opportunity to use the orbital complex in its entirety. But no one knows yet whether Russian cosmonauts will get to operate the Alpha at all. The fact is that all the know-how with regard to the development of the orbital station has been valued at $800 million. Even though Russia herself invested tens of billions of rubles in that technology at a time when the ruble and the dollar were almost equivalent.

But since the whole station will go for roughly $40 billion and will be operated by the project participants on a percentage basis, according to how much was contributed, Russia's operating time will be no more than 10 days a year. When you recall that we have obligations to France in the manned program, then it's not clear at all for whom or for what purpose we will be creating Alpha.

Besides, Russian industry will lose vitally important orders. And the unique Cosmonaut Training Center in Zvezdnyy Gorodok will become virtually unnecessary—the crews will start training in the States. And the Flight Control Center, with all its expensive equipment and highly skilled specialists, will lose its significance.

Russia Seen as Equal Partner

947Q0097B Moscow ROSSIYSKAYA GAZETA in Russian 16 Mar 94 p 3

[Article by Boris Ostroumov, deputy director of the Russian Space Agency: "...Not Assistants, But Partners"]

[Text] We're fighting for survival. This year, despite all the ukases and decrees signed, we've received only one percent of the money promised from the budget. Had we not found additional financing from abroad, we would have ceased our operations long ago. That is why the draft of the agreement is, in fact, beneficial to us. Yes, the amount of money allocated to us by NASA seems insignificant. But that's all the American space agency could afford from its budget. And yet, that's certainly not the only source for attracting hard currency. All the rest of the revenues will be decided on at the level of the manufacturers themselves. That means direct ties and agreements between, say, the Boeing firm and NPO Energiya, or between Rockwell and the Yuzhnoye Design Bureau. Each individual assembly, rescue craft, spacesuit, and so forth—for all that there are tenders, income, contracts. With that, we agreed from the very beginning that the price of an item would be based on the value of a norm-hour of work of the engineer and the manufacturer in American terms. And there are already three such contracts.

Yes, we are conducting negotiations that are not very simple. The complexity of our position stems from the fact that we entered that stage when the initial draft of the agreement was already worked out.

What is fundamental is the station's name itself. We are insisting that the station have international status. The Americans prefer to call it an American station, with participation by foreign partners. We haven't forgotten for a minute that the most crucial work has fallen our way—the creation of a space infrastructure. That represents a solid contribution in terms of power engineering, life-support-system work, and the organization of freight flow. All that, based on the totals for each period of operation of the station, should be assessed by a joint council. And each contribution is evaluated in money terms, and the jointly acquired information divided up on the basis of that.

Moreover, we will work to see to it that Russia gets the right not only to work independently on its autonomous module, but also to use all the station's equipment for its work. We have signed an intellectual property agreement that stipulates that information acquired jointly also belongs to all the countries that have taken part in acquiring it.

And the fears of the loss of the Flight Control Center and the Cosmonaut Training Center are unfounded. As we know, not only have Russian cosmonauts gone through training in the United States, but vice-versa. And it would also be impossible to close the Flight Control Center: it's a huge science center that's linked to more than just a station.

The alternative of creating a station with ESA is also unrealistic. The Europeans, no less than the Americans, operate on the principle of "money up front." Russia can't enter ESA, because we don't have the money for the entry share.

The orbit chosen for the station is based on the technical capabilities of the shuttles, but that doesn't mean that the United States is in a more advantageous position than we are, because they prefer to perform studies of the ground with satellites.

It's my hope that the agreement draft under discussion, after being signed by the President of Russia, will attach particular significance to the fulfillment of the obligations made in connection with it.

Head of Plesetsk Cosmodrome Argues for Expansion of Capacities

947Q0102A Moscow SEGODNYA in Russian 17 Mar 94 p 9

[Article by Veronika Romanenkova and Semen Ivanov: "'Mirnyy' [Peaceful] in Actuality Wants To Be Such and Does Not Forever Want To Be a Backup"]

[Text] The launch of the latest space vehicle from the Plesetsk cosmodrome took place in the early morning, but lights burned in many windows of houses in Mirnyy city, the Plesetsk "capital": people awaited the launch. Although launches of space rockets long have been commonplace for the local inhabitants, in every case excitement prevails.

In a city with a population of 50 000 it is the military personnel, sometimes risking their lives, who constitute the "backbone." Two major accidents have occurred here, in 1973 and 1980. Nine died in the first case and more than 50 in the second.

The official date of founding of Plesetsk, initially a defense base whose R-7 intercontinental missiles were aimed at the United States, is set at 15 July 1957. In 1964 a decision was made to reoutfit and reorient the Plesetsk rocket facilities.

Today four types of boosters (Soyuz, Molniya, Tsiklon, Cosmos) are launched from the northern spaceport and nine types of satellites are put into orbit for scientific and economic purposes: Bion, Resurs, Foton, Molniya, Meteor, Okean, Musson, AUOS, Nadezhda. Military satellites also are launched from here.

Launches at Plesetsk take place from nine launch complexes scattered over the Arkhangelsk taiga. Rails, along which rockets with satellites are transported from the hangars of the repair-test facilities, extend to the launch pads. The launch pad for the Tsiklon-3 booster, for example, prior to the arrival of a rocket is an extremely modest concreted surface with a rise. However, when a rocket is brought up an erector rises from the ground surface and this is used in bringing the rocket into a vertical position. After several minutes it occupies its initial position.

The most dangerous stage in preparing rockets for launch is their fueling. The fuel used is ultratoxic asymmetric dimethyl hydrazine and nitrogen tetroxide. Specialists fill the tanks of their stages while wearing gas masks and special protective suits because this is a fuel which if it gets on the skin threatens very severe burns. The quantity of fuel for each type of rocket is different, but in any case it is more than 100 tons.

The soldiers of the military space forces have several prelaunch traditions. The commander never scolds his subordinates at the launch pad. If any irregularity is discovered, it is rectified under exceptionally calm conditions. On the other hand, after the launch a "flight debriefing" is carried out. Prior to each launch of any booster the last person to leave the launch pad is the commander, the head of the military unit, thereby taking all responsibility on himself.

At the present time Plesetsk is the busiest spaceport in the world: almost 70% of all Russian satellites are launched from here and for the time being it is the only cosmodrome in the Russian Federation. In contrast to Baykonur, heavy boosters of the Proton type, carrying space vehicles into distant space and into stationary orbits, as well as manned ships, are not launched from here.

In addition, the project for constructing the Alpha international orbital station, as well as the further implementation of the Russian- American Mir-Shuttle program, are oriented on launches of boosters solely from Baykonur (territory of a "third" country, Kazakhstan).

However, Major General Anatoliy Ovchinnikov, chief of the Main Center for Tests and Use of Space Equipment, feels that his facility is best suited for the solution of these problems. The territorial location of the cosmodrome, far from the equator, which requires a greater power for the launch of some space vehicles into orbit, gives rise to some problem which, to be sure, is solvable. On the other hand, precisely the Arkhangelsk taiga and tundra—a poorly populated terrain—are convenient for regions of falling of spent rocket stages. In addition, here there is a minimum effect from the radiation field, which is important for the purity of scientific biological experiments.

At Plesetsk, asserts the head of the cosmodrome, there is no need to undertake new construction, only to complete some structures and to carry out reconstruction of the "habitat." The buildup will require about five billion rubles in 1992 prices, three billion of which have been promised by the president of Russia. For the time being even the reception of guests is an enormous problem. Although several buildings are called hotels, to adapt to existence in them is extremely tough: the paint is peeling from the walls and the ceilings in places threaten to come down on your head; they are scarcely heated, so that in winter it is necessary to sleep in one's outer clothing and hot water also is not to be had.

According to the "native inhabitants" of Mirnyy, they do not live much better. By no means do all of them have apartments, they live in common quarters where conditions are even worse than in the hotels. The same conditions apply with respect to heat and hot water.

As stated by Anatoliy Ovchinnikov, many of the personnel, especially from the Ukraine, have virtually disappeared from Plesetsk, whereas many of those serving at Baykonur, where things are getting worse, are striving to resettle in the north. And nevertheless there are insufficient personnel for the full staffing of military units: highly qualified specialists receive the same pay as the remaining military personnel, plus a differential for serving in the north which is "eaten up" by the higher prices in the stores.

There also are many difficulties with the development of space equipment. For example, only a few specialists who assemble solar cells for space vehicles have remained in Russia. This very intricate manual work requires not only high professionalism, but also infinite patience: from platelets measuring only a few millimeters it is necessary to "glue together" a panel of solar cells whose area is several square meters.

Despite all these difficulties, by investing considerable sums in Plesetsk, according to Anatoliy Ovchinnikov, by the year 2000 it could be made ready for launches of heavy boosters and manned ships. However, according to the calculations of specialists of the military space forces, it would be more efficient to spend this money on constructing a new cosmodrome in the Far East. At Plesetsk, evidently, only the launch pads for intermediate-class boosters of the Zenit type will be completed and at the future eastern cosmodrome by the beginning of the 21st century there will be two launch facilities for boosters of the Proton type, but in a more modern variant which is ecologically clean.

Plans To Build New Russian Cosmodrome in Amur Region Viewed

947Q0099 Moscow ROSSIYSKIYE VESTI in Russian 17 Mar 94 p 12

[Comments by Vladimir Polevanov, governor of Amur Oblast, to Nikolay Beliy, special correspondent for ROSSIYSKIYE VESTI, dateline Amur Oblast: "Will There Be a Cosmodrome on the Amur?;" first paragraph is source introduction]

[Text] **The large national project for the construction of a new Russian cosmodrome on the Amur could wither in the "coordination" stage. Commenting at the request of the ROSSIYSKIYE VESTI correspondent on the possibility of the construction of a new domestic cosmodrome between the Amur and Zeya rivers, the governor of the Amur Oblast, Vladimir Polevanov, had no idea, it seems, what effect his affirmative response would engender.**

The issue centers on the creation of a unique testing ground from which heavy-lift launchers such as Proton, Zenit, and even Energiya would be able to place in orbit virtually any space vehicle. Whether the far reaches of Russia will become the space "New Vasyuks" is a question that, more than anything else, depends on money.

But the position of the leadership of the oblast is pragmatic and therefore, on the outside only, appears immovable. The project—if, of course, it is carried out—will bring into the weak economy of the Amur region large capital investment, will create new jobs, and will raise the prestige of a poor far eastern province. The opposition has its own radically opposite point of view: the idea is bad, and the site itself won't hold up to criticism.

You'll recall how three years ago, in this same place, in the Amur region, a project almost as large and of an international nature was successfully frozen. At that time, when the first administration of the Amur Oblast was still in office, the plan called for throwing up an automobile/train bridge across the border-running Amur, near Blagoveshchensk. Now the third administration is in office. But everything is still the way the dacha holders across whose plots the transcontinental highway was to be built decided long ago it would be. The bridge isn't being built, even though there is even a special decree of the Government of Russia to have it done. Won't the new project, which also has an international significance—China and Japan have already shown their interest in it—meet the same fate?

Before it even came about, the project divided scientists, specialists, and residents of the region into two camps. The opponents of the Russian Baykonur are facing an entire social committee created to protect the future cosmodrome. Newspapers boldly manipulating the "public vote" are drawing horrible scenes of massive catastrophe. The far easterners are predicting a global apocalypse: the stages from the spacecraft that are launched will start falling on the heads of the Amur residents, and the jarring of the soil will cause earthquakes, which will cause the Zeya Hydroelectric Station reservoir to fill up to the brim, and the water will break the dam, and every living thing for hundreds of kilometers around will perish.

But the local residents are responding calmly to the gloomy predictions, and no one is running out of the places where the construction is supposed to be. Just the opposite—people are declaring their readiness to work on Russia's future launch complex. A purely economic factor is at work: getting permanent, high-paying work and joining the ranks of contractors for a project that has state-level status means resolving the issue of one's own well-being, not to mention survival. Judging from everything, that's how the situation was sized up by the group that makes up the Amurstroyproyekt joint-stock company, one of the first to proffer its services to the military.

Why the military? The fact is that the new Russian cosmodrome is expected to be built in places in which, until only recently, the military were the main dramatis personae. The missile units, closed to journalists and concentrated in the forests and knolls near the Amur section of the Trans-Siberian Railroad, all went under the name of Svobodnyy-18. Not far from Svododnyy were the "articles" with nuclear entrails. Missiles without warheads were, the military say, launched from the silos there on a regular basis, and nobody had a problem with that, because, they say, nobody knew about it.

Thanks for the disclosure, especially since it comes from someone who should know. From, for example, the strategic missile forces division commander, Maj.-Gen. Aleksandr Vinidiktov. In doling out information to the

press, he told about how, today already, they—the military—are literally being assaulted with requests that they employ machine operators from nearby settlements. They're taking many of them.

The residents themselves of the town of Svobodnyy-18 are divided about the possible transfer to the aegis of the military-space department. Most of the officers, who often work without pay, are for it. Space to them is not just some abstract world—it's a means of achieving strictly earthbound goals. The facility, my conversation partner assured me, presents no serious danger. the nuclear weapons that used to be in the military units (those missiles have been removed from the military's possession) represented a much greater threat to the entire region.

But the issue of the construction of a far eastern cosmodrome is not yet settled. Having studied the circumstances, specialists have acknowledged that Svobodnyy-18 is one of the best places in Russia to build a space launch complex. In fact, it won't even be a cosmodrome, but rather the main center for testing and adapting space systems. Again, that's if it ends up there. One thing is certain and indisputable: there won't be any nuclear testing in that center.

Despite the encouraging last phrase of the professional missileman, the decision won't be an easy one for Moscow or Blagoveshchensk to make. Local patriots suggest that the Russian Baykonur be built wherever is best, but not on the Amur. Of course, one can't tackle such a grandiose project, one that is capable of attracting the attention of the world community, without performing in-depth analysis, above all ecological analysis. But what's also indisputable is the fact that the fate of a facility that is strategically important for this power can't be decided by a simple vote. By the way, in America, they built a cosmodrome in a resort state, Florida, on the basis both of national interests and local interests. But this issue, I repeat, is a state issue and isn't to be resolved as if it were otherwise. In fact, we're not Florida.

Buran Simulator To Be Opened as Tourist Attraction

947Q0105A Moscow DELOVOY MIR in Russian No 58, 22 Mar 94 p 8

[Article by Sergey Sobolev, DELOVOY MIR correspondent: "Press Button for Launching!"]

[Text] "... 4, 3, 2, 1... launch!"—such were the approximate words of German Titov, cosmonaut No 2, president of the Kosmos-Zemlya joint-stock company (AO) on the morning of 12 April—"lifting into the air" the Buran orbital ship with 48 passengers aboard. It goes without saying that the space shuttle chassis does not rise a millimeter above its site on the Pushkin Embankment in the Gorkiy Central Park of Culture and Rest. The unique attraction is being opened on Cosmonautics Day. By means of monitors and computers it creates the total illusion of spaceflight.

A complex operation preceded the appearance of the supersecret space technology at the center of Moscow. In fact it was transported on a special barge along the Moscow River from the NPO Molniya and the Tushino Machine Building plant; it was even necessary to lower the water level in the river by 20 cm for this purpose in order for the multiton monster to be able to pass under all the bridge spans.

This Buran has not been in space. It is one of the more than 10 ships constructed by Molniya and intended for surface tests. It had successfully passed these tests. Specialists say that if engines were mounted on it and it underwent certain modifications it would be able to make a spaceflight. But, as is well known, the highly touted project was put on the shelf. And our Buran would not live on if it were not from dreamers at the AO Kosmos-Zemlya.

They found a place for attractions and leased from the Central Park of Culture and Rest a half-hectare of land for a term of 20 years and outfitted a site for the ship. Then it was delivered to the site and now "preflight" work is at its height.

"The tourist 'space voyage' is to last for two hours," says Semen Lvov, general director of the AO. "The participants on the journey will occupy seats in the comfortable passenger cabin of the orbital ship. Then they will be familiarized with the structure of the Buran and the conditions under which it performs flight, learn about safety rules, will be able to participate in flight control and assist the crew in warding off a meteor attack. For some time they will experience a state of weightlessness and then the illusion of flight will be absolutely complete."

The ship has "entered" a circumterrestrial orbit. Now it is time for a snack. Everyone is offered a dinner of real space food. The menu consists of more than 100 dishes prepared at the Institute of Nutrition for Space Technology for real cosmonauts. All the foods are tasty, nutritious and ecologically pure.

"We will require 300 servings per day," continues Semen Lvov. "This is virtually a year's production for the institute. Accordingly our attraction, it might be said, will save it from bankruptcy and will prevent unemployment.

"Circus actors have been invited to fill the 'jobs' of crew members and in the course of the 'play' their role will change. They even will be extraterrestrial beings. The stewards and stewardesses are now being recruited and trained. Incidentally, the company is inviting young people and girls to participate in the competition. Attractive and high-paying work in 'space' awaits the winners."

"The Buran passengers will receive personal tickets the same as plane passengers. In addition, they will receive special certificates as spaceflight participants. It goes without saying that this is nothing more than a pleasing souvenir, but nevertheless..."

"The 'flight' will cost an average of 29.50 dollars (in current rubles). The relatively high price for the most part is attributable to the expensiveness of the food products. The cost of the tickets varies, depending on the time of the flight (evening flights are more costly), on the makeup of the passengers (any sum may be charged for rich tourist groups). Plans call for complementary 'flights'—for orphaned children, for veterans of the Afghan war, etc."

"Advertisements of different Russian and foreign firms are being placed on the Buran fuselage, on the chassis panels, on the lighting towers and showcase displays. Even now the director's office has received more than a few applications for the placement of advertisements. The site of the attraction is clearly visible from the Moscow River embankments and from the Crimean Bridge, along which passes one of the heavily travelled city routes—the Sadovoye Ring. Between May and October recreational ships pass up and down the river; one of the wharves is situated on the grounds of the attraction. By agreement with the leading tourist agencies the attraction will be included in all tourist excursions. Incidentally, it is planned that tickets for the 'space flight' will be sold at all airports in the world from which flights to Moscow are made."

"The cost of 1 square meter of advertisement on the fuselage for six months is 3500 dollars or their equivalent in current rubles. The cost is less for the chassis panels, lighting towers and display showcases."

"We do not intend to transform the Buran into a messy billboard," declared Yuriy Klebanov, the AO senior manager. "The advertisement will be moderate, of excellent quality and taste. If the number of applications exceeds the possibility for placement of advertisements we will hold a competition for advertisers. We wish that the spaceship—one of the highest attainments in world space technology—will become a favorite attraction for thousands of people."

Interest of Military-Space Forces in Svobodnyy-18 Cosmodrome

947Q0103A Moscow SEGODNYA in Russian
24 Mar 94 p 9

[Article by Veronika Romanenkova and Semen Ivanov: "There Is an Alternative to Baykonur. Get to Work, Comrades!"]

[Text] According to the calculations of specialists, only two years are needed for beginning launches of light boosters from the new Russian cosmodrome Svobodnyy. And although a special decree of the government on its establishment and a directive of the president of the Russian Federation on the designation of Aleksandr Vinidiktov as the head of the Main Center for Tests and Use of Space Equipment is expected in the immediate future, the Military-Space Forces are already in action.

The end of the cold war brought to the brink of extinction the one-time most powerful branch of the armed forces: the Strategic Rocket Forces. Under the conditions of the agreement on reduction of strategic aggressive arms (START II) the two powers are continuing the process of mutual disarmament, thus reducing the confrontation to a lower level. According to the agreement, up to the year 2003 in Russia, in particular, surface intercontinental ballistic missiles (ICBM) of six types will be destroyed, including the heavy RS-20 (SS-18 in the American classification) which caused the greatest worry beyond the ocean. This 30-m "cigar" was the most powerful missile in the world and not without reason in the United States was nicknamed the "Satan." With a launch weight of more than 200 tons it carried 10 individually guided nuclear warheads (the power of each of which was equal to 11 of the atomic bombs dropped on Hiroshima) and it could transport 8.8 tons for a distance of 11 thousand kilometers. The latest American 10-warhead Peacekeeper ICBM with a launching weight of 88 tons could deliver only 3.95 tons for this same distance.

As a result of implementation of Start II, only one kind of ICBM will remain in Russia—the solid-fuel RS-12M (SS-25)—both in the now-existing mobile variant, and in the permanently based variant to be developed. This creation of Votkinsk machine builders (Udmurtia) has no standard-produced analogues in world rocket building.

The first to be destroyed will be rockets developed and constructed at earlier times: RS-10 (SS-11), RS-12 (SS-13) and RS-16 (SS-17). In addition, those ICBM which are constructed outside Russia, in the Ukraine, will be removed from the armament of the Strategic Rocket Forces: these are the RS-20 and the RS-22 (SS-24). American ICBM also will be destroyed (the Peacekeeper, known in our country as the MKh) or will be rebuilt into single-warhead missiles (Minuteman 3).

By the beginning of the 21st century some of the 20 Russian regions of deployment of combat rocket complexes of the Strategic Rocket Forces will cease to exist.

Until recently Svobodnyy-18 remained the most easterly region of deployment. The armament there consisted of 60 RS-10 ICBM aimed at targets of the probable enemy. It so happened that a similar decision on the reoutfitting of the defense facility at Plesetsk into a space facility was made almost 30 years ago. Now the same decision has been made with respect to the rocket division at Svobodnyy-18.

It is very simple to blow up the tens of silos outfitted with unique equipment, which, however, had already been partially done at Svobodnyy-18. But the defense capability of Russia and its guaranteed access to space would remain in question due to the unresolved status of Baykonur and the possibility that the Kazakh side will advance ever-newer leasing conditions. Accordingly, the former military facility will be preserved, but it will play

a different role, as the Main Center for Tests and Use of Space Equipment, as part of the Russian Military Space Forces.

As planned by the Military Space Forces, the Svobodnyy cosmodrome in the initial stage will consist of two launch pads. After two years, in 1996, light space boosters of the Rokot type will be launched directly from the former silos. They also were constructed on the basis of RS-18 (SS- 19) combat missiles and already have been twice launched from Baykonur. Later three additional silos will be allocated to the Rokot.

But the principal task of Svobodnyy will be the launching of heavy boosters, for which two additional launch facilities will be constructed. Now the NPO Energiya, Khrunichev Scientific Production Center and the Makeyev Design Bureau at Miass (Chelyabinsk Oblast) are developing projects for a new generation of heavy two-stage boosters to be called the Angara-24.

Among the requirements imposed on the future rocket the most important is ecological cleanness. As the fuel for it specialists most likely will use nontoxic components—liquid oxygen and hydrogen, as well as kerosene. The first stage and the nose cowling will fall to the ground. In the future the first stage will become multiply reusable and will make a gliding descent to the launch site. The second stage will be put into a reference orbit by command and will burn up in the atmosphere.

The deployment region of the rocket division occupied several tens of square kilometers in Amur Oblast. With the reoutfitting of the facility the area will be reduced in size and lands will be returned to the oblast. Svobodnyy-18—the "capital" of the cosmodrome and the former military city—is located approximately 200 km from Blagoveshchensk.

As stated by Vladimir Polevanov, doctor of geological and mineralogical sciences, administrative chief of Amur Oblast, clear sunny weather prevails here 300 days a year. In winter, in January, there are only several days when the temperature drops to -30 degrees. Even melons and grapes grow here in summer. Amur Oblast is a far-outlying province of Russia.

The head of the oblast is convinced that with the appearance of the new cosmodrome the region will "boom"; not only state investments will come here under the federal program for construction of the spaceport, but money will begin to be invested for development of the infrastructure, industry and commerce. In addition, due to the cosmodrome the oblast will receive new technologies and jobs, will receive profits from possible commercial launches and information from satellites launched at Svobodnyy will help in exploring regions where minerals may be present.

Most of the local population for the time being is against the plans of the Military Space Forces and the oblast administration. The people feel that launches of space rockets are more dangerous than the nuclear warheads positioned here earlier. Here an unprecedented flourishing of the environmental movement also is noted, despite the fact that the future builders of the spaceport vow to preserve the ecological purity of the region.

The Russian Space Agency (RSA) also is wishy-washy about the new idea. The opinion prevails at the agency that the project is unrealistic because Russia does not have the funds. It is true that the disapproval of the RSA may be related to the desire that the Military Space Forces not "retreat" from Baykonur, where they fully support all launches.

So that the words of Colonel-General Vladimir Ivanov, commander of the Military Space Forces, that Svobodnyy is "not a retreat, but on the contrary, an active advance," have a dual meaning. On the one hand, this is a base for the development of Russian unmanned cosmonautics. On the other hand, it represents a strengthening of the position of the Military Space Forces in its relations with Kazakhstan (in the event of the next unrealistic demands which it advances with respect to Baykonur) and in its relations with the Russian Space Agency, which will be forced to play second fiddle at Svobodnyy if it becomes the sole possible place for implementing manned programs.

Both Sides Said To Be Winners in Baykonur Lease Agreement

947Q0108 Moscow KRASNAYA ZVEZDA in Russian 30 Mar 94 p 1

[Article by Oleg Falichev: "Russia Is Staying at Baykonur"]

[Text] So the prediction by KRASNAYA ZVEZDA about the outcome of the Russian-Kazakh negotiations was virtually completely right. And apparently it was because the logic of life itself—especially the life of the recent difficult years—prompted the two republics to search for a solution in a more intimate integration and strengthening of friendly ties.

Perhaps one of the most important document signed by Presidents Boris Yeltsin and Nursultan Nazarbayev was the Treaty on Broadening Further the Cooperation and Integration Between Russia and Kazakhstan. Specifically, it lays the foundation for cooperation in areas such as economics, culture, and law. Also extremely important are the Agreement of Strategic Nuclear Storage Facilities Temporarily Located in Kazakhstan, the Treaty on Military Cooperation, the Memorandum on the Basic Principles for the Resolution of Issues Associated With the Civil and Legal Status of Citizens of Kazakhstan Living in the Russian Federation and of Citizens of Russia Living in Kazakhstan. In all, more than 30 documents were signed.

As we also expected, some problems arose in connection with the resolution of the issue of the fate of the Baykonur Cosmodrome. But there, much was done by

those working on the joint agreement during the preparatory period of the delegation. And although the last word was still with the presidents, the changes they inserted into the agreements on the status and conditions of use of Baykonur and the city of Leninsk turned out to be insignificant. The cosmodrome, under development for many years during the time of the Soviet Union and from which the first launch was made, on 4 October 1957—as well as from which the first cosmonaut, Yuriy Gagarin, lifted off, on 12 April 1961—remained under lease to Russia.

The term of the lease is 20 years, with an extension of 10 years. The Russian side maintained its position on Russian citizens—military servicemen of the Military Space Forces of the Russian Federation—staying at the cosmodrome and servicing it. The lease price: $115 million a year. The director of the Russian Space Agency, Yuriy Koptev, had this to say about that: the Russian-Kazakh agreements reached in Moscow acknowledge Russian jurisdiction over the cosmodrome. That means that the Russian citizens and military servicemen will live under Russian law.

With the Baykonur lease, we emphasize once again, both sides win, the citizens of both republics win. As for the people in shoulder boards, who, by the nature of their activity, are used to following strict regulations and clear laws, these agreements—including the Treaty on Military Cooperation—are particularly important to them. And what they say is that the period of uncertainty in Russian-Kazakh relations is behind us. That, like it or not, all of us have to swim together to the new shore under the rubric of "cooperation." That the popular wisdom that say that one old friend is better than two new ones is right.

Revised View of 1980 Launch Accident at Plesetsk

947Q0107 Moscow ROSSIYSKIYE VESTI in Russian 31 Mar 94 p 12

[Article by Dmitriy Ivanov, experimental engineer for rocket and space hardware: "Explosion on the Pad"; first paragraph is source introduction]

[Text] **That explosion at Plesetsk took dozens of lives. The living and dead participants in the unsuccessful launch were pronounced guilty. Today, almost 15 years later, we can look at the situation differently...**

On 18 March 1980, on launch pad No. 4 of the Plesetsk Cosmodrome, during the preparations for the launch of a Meteor launch vehicle, an explosion took place. Fifty-one people died, and several dozen were injured. The launch vehicle and the spacecraft and some of the ground equipment were destroyed. The launch structure and the launch pad required major repairs.

Immediately after the accident was reported, a State Commission was set up, headed by the deputy chairman of the USSR Council of Ministers, L. V. Smirnov. In the span of two months, the commission came up with several versions of the possible causes of what took place and set up several experiments to check them. But the objectiveness of the commission's conclusion couldn't help but be influenced by the large measure of potential responsibility that the various officials would have for such a grave occurrence or by the departmental interests and service ties of the experts.

The results of the commission's work were laid out in several dozen volumes. The lead volume contained the commission's report, in which the cause of the accident was pronounced to be the improper, unsanctioned actions of the servicing crew (specifically, of Pfc Velikoredchanin) in stopping a leak of liquid oxygen with an irregular method. Pronounced indirectly at fault for the occurrence were the leaders of the servicing crew, who were responsible for the correctness of the designs adopted, the adherence to the necessary discipline in conducting the operations, and the technical training of the personnel.

The investigations came to an end, the orders were issued, those remaining had to go on living and working. But besides the sense of unfairness that attached to the punishments, there was alarm at the fact that the true causes of the accident had not been fully unearthed and that they would happen again, no matter how carefully a program of measures to avert them was drawn up. On 23 July 1981, an emergency situation occurred again, during the preparations for launch of a Soyuz launcher on pad No. 1 of the Plesetsk Cosmodrome.

Upon the completion of the fueling with hydrogen peroxide, the crew reported serious heatup of the filter housing in the ground pipeline, which indicated that the component was breaking down inside. It managed to stop further progress of the process, which could become explosive at any moment, by immediately draining the peroxide from the pipeline. When the filter was examined, it was found that solder had melted, which could have happened only at temperatures of several hundred degrees. In light of the fact that concentrated hydrogen peroxide tends to explode at temperatures above 90 degrees, one gets an idea of all the danger that arose with the situation, danger that not only the experience of the leaders and the level of training of the crew helped to counter, but also a good amount of luck.

Studies of the filter showed that the soldering by the manufacturing plant had been done not with pure tin, which is neutral to hydrogen peroxide, but with a tin-lead solder, which became a catalyst for the breakdown. After that, it was established that the use of that very solder had been ordered in the design documentation. As it turned out, when the documentation was corrected, not long before the accident in 1980, the type of solder was "simply" mixed up in the KB General Machine Building (the head developer of the launch system).

This became clear to specialists: the unusual catalyst had been found, the chain of evidence of the correctness of

the "lower" version was completed, and the groundlessness of the "upper" version became even more apparent. The intentions of the critics of the official conclusion were very firm. But to prove with documentation that the rocket in the accident had been assembled with a filter that was substandard is impossible today. The most pointed accusations were made in the clay of collective irresponsibility. All that, based on the presumption of innocence, did not make it possible to regard the cause of the accident as proven in a judicially strict manner, no matter how obvious it was to specialists. One way or other, further investigation ceased. The decision adopted by the command was diplomatic: the penalties imposed were lifted, but not taken off the record, and those punished were not acquitted of all charges, but were pronounced to be "now free of the earlier noted shortcomings."

So what can we give today as the final assessment of the causes and effects of the tragedy of 18 March 1980?

What we now know is fully sufficient for the absolute and final acquittal of the living and the dead who 14 years ago were accused in haste and unfairly. Their fate is largely typical, however paradoxical and hard that may sound. During the postwar years at the testing grounds and cosmodromes of Kapustin Yar, Baykonur, and Plesetsk, interdepartmental commissions investigated several hundred unforeseen occurrences without loss of life, and in only a handful conclusions was the cause pronounced to be error on the part of the servicing crews. In those instances accompanied by loss of life, however, it was the servicing crew—those who died, as a rule—that was, with few exceptions, pronounced guilty. The temptation to use the dead, who couldn't respond, as the chief offenders was too great. The effect of such an approach was reflected in the results of the investigations of many other accidents, and the "convenient" decisions not only soiled the memory of the dead, but also maimed the living.

Restoring the truth is necessary, and perhaps it should be done quickly, while those who took part in the events are still alive and before all the materials classified "Keep Indefinitely" have been destroyed.

RSA Deputy, Space Designer Comment on Plan for Far East Cosmodrome

947Q0106A Moscow ROSSIYSKAYA GAZETA in Russian 2 Apr 94 First Edition p 3

[Article by Boris Ostroumov, RSA deputy general director, and Igor Barmin, general designer, General Machine Building Design Bureau: "What Will the New Cosmodrome Be Like: 'Costly as a Diamond' or Very Necessary?"; the first paragraph is an introduction]

[Text] The report on the establishment of still another cosmodrome in the Far East by the year 2000 was received with mixed feelings by space branch specialists. But will these disputes lead to the appearance of still another spaceport? We asked leading branch specialists to express themselves on this matter.

Boris Ostroumov, deputy general director of the Russian Space Agency:

The ITAR-TASS communication carried reproaches directed toward our agency to the effect that the project for the Alpha international orbital station which we approved is completely oriented on Baykonur and that under the prevailing conditions this is complicating its implementation. "Accordingly, for Russia to carry out an independent space policy and ensure guaranteed access to space Russia has been forced...to proceed to the reoutfitting and construction of a new cosmodrome."

First of all, I wish to be more precise and once again remind: the project for the Alpha international space station has not been finally adopted by all the partners and is being prepared for signature only with great difficulties. Many points are being refined and the interests of Russia are lagging behind. We are even trying not to use the very name Alpha..

The fact that the project is oriented on Baykonur is entirely natural: today it is the sole operational gateway into space with a well-developed infrastructure. For example, the assembly-test facilities constructed for the Buran are outfitted with the most modern apparatus. Baykonur ensures launches of space vehicles into the necessary orbital inclinations. While we are not losing hopes for success in negotiations with the Americans, we have had to exercise still more wisdom and restraint in the dialogue with Kazakhstan. The results of negotiations indicate that despite the efforts of many shortsighted politicians there can be no falling out between our peoples.

The establishment of a new cosmodrome in the Far East is an expensive idea. I have already mentioned before that "each stone there will be more expensive than a diamond." In Russia today there are no funds even for ordinary bricks and blocks. The remoteness of the new cosmodrome from manufacturing plants also will transform it into too expensive a facility.

In my opinion, today, when preparations are being made for ratification of the documents signed with Kazakhstan, to raise a discussion about an "alternative" variant means to drive a wedge between the covenanting parties.

Igor Barmin, general designer of the General Machine Building Design Bureau:

The problem of establishing a cosmodrome in the eastern part of the country has a multisided character. Without question, Russia must have its low-latitude cosmodrome not only for implementing space programs, but also for solving problems of defense importance. The choice of a place for the construction of a new spaceport also has its pluses and minuses. It is fortunate that the construction will not be carried out in a barren place but

at the base of a military unit already having a quite well-developed infrastructure. Unfortunately, the fulfillment by Russia of its obligations for disarmament has the result that much is experiencing an arbitrary fate. The choice of the place also is fortunate with respect to the allocated falling zones.

A shortcoming is the great expenditures related to the remoteness from scientific research institutes, design bureaus and manufacturing plants. However, in my opinion it is incorrect to consider the construction of a new cosmodrome as an alternative variant to the Baykonur cosmodrome.

The project for the new cosmodrome can be fully examined only when its tasks have been clearly set forth and the programs for whose solution it will be intended have been defined.

Only after serious and thorough working through of all these questions can a decision be made about the stages in its development and the time when it will be established.

Political Maneuvering on Baykonur Cosmodrome Issue

947Q0110 Moscow KOMMERSANT DAILY in Russian No 59, 2 Apr 94 p 4

[Article by S. Tsekhmistrenko, under the rubric "The World Over the Week": "Space Passions in Nonintegrated Expanses"; first paragraph in italic is from poem by Chingiz Aytmatov, "Stormy Flag Stop (And the Day Lasts Longer Than a Century)"]

[Text]

And again the trains were running from the east to the west and from the west to the east...

And off to both sides of the railroad in those parts were all the desert expanses that had been untouched since time immemorial—the Sary-Ozeks, the Midlands of the yellow steppes.

There was not even any mention of the Sary-Ozek-1 cosmodrome back then. Maybe it was only being drawn in the plans of the future creators of space flight.

But the trains still kept running from the east to the west and from the west to the east...

Forgotten in the endless Kazakhstan countryside, the "stormy flag stop" of our day is Tyuratam (that—from the name of the closest railroad station—is what the Russian military are used to telling everyone is the name of the well known Baykonur cosmodrome), which has, unexpectedly for most of our contemporaries, found its way to the epicenter of the serious passions that have flared up in recent months between Russia and Kazakhstan. Who could have imagined that the Kazakhs at the end of the 20th century would want to trade their customary steeds and camels for places in space vehicles. But the cunning intrigue that has surrounded Baykonur was topped recently with a no less cunning decision.

Nursultan Nazarbayev could easily be considered the creator and main persona of the intrigue. The bargaining with Moscow on Baykonur he conducted unhurriedly, having begun it when Kazakhstan announced its independence—on 31 August 1991. That day, a delayed-action mine was laid: the cosmodrome, the city of Leninsk, and all the movable and immovable property in the city were declared to be the property of Kazakhstan. That moment could have signaled the end of the cosmodrome—not wanting to invest any money at all in Baykonur (since everything would go to Kazakhstan anyway), Moscow nearly lost interest in it. But Moscow had a change of mind in time, after it apparently saw that carving out an alternative route to the stars would be fairly difficult in the coming years. And national pride played a role, too: why was it, specifically, that we had to give up what had been built by forces of the "new historical community—the soviet people," where the Kazakhs are just a part of the whole?

Such thoughts came to Nazarbayev's mind much earlier than they did to Yeltsin's mind—as early as 1992. That was when he first got the idea to create an international consortium at Baykonur. To put it simpler, lure Uncle Sam to those virgin expanses. The idea was then buried—because Uncle Sam already has a cosmodrome in Florida and wasn't very sanguine about pouring dollars into the Kazakhstan sand. Replacing that idea was the lease—that was what Alma-Ata proposed that Moscow do with Baykonur last December. And Alma-Ata asked what seemed a very modest sum—$40 billion a year, which later changed to $7 billion, and later yet was halved to $3.5 billion. Andrey Kozyrev, who had prepared the Russian-Kazakh summit, centered his dialogue with Alma-Ata in February on the last figure. The dialogue was reminiscent of the joke from bazaar life: "How much are the flowers?" "Twenty thousand each." "Why so expensive?" "I need money bad."

In order to force Moscow to be more compliant, Nazarbayev prepared for it an almost Christmas surprise. Even two. Early in the year, rumors were circulated on a consortium, and the rumors were confirmed by the January visit to Kazakhstan of a delegation from America's NASA. The aeronauts [sic] signed an agreement with Alma-Ata about nothing less than the conduct of joint observations of outer space and of space-vehicle fragments that could be hazardous to orbital facilities (you can imagine the face of the commander-in-chief of the military space forces of Russia, Ivanov, when he got the news that Russian fragments would be studied by foreign uncles!). And Nazarbayev, who was in Kiev about that time, reached an agreement on some sort of joint space program with Leonid Kravchuk. Negotiations were held on the deployment at the cosmodrome of some sort of "international space forces" hardly under the aegis of the UN, in which the Russians certainly wouldn't have the role of first violin. Those steps were

viewed by Moscow with poorly masked irritation—it wasn't about to share Baykonur with anybody.

Many years will have to pass before it becomes clear to what extent Nazarbayev's actions were calculated and to what extent they were a bluff. Certainly, aeronauts on the banks of the Dnieper couldn't even imagine themselves sipping fat through tubes one fine day aboard a spacecraft flying the yellow-and-blue flag. In actuality, there's enough money today to get to, maybe, the middle of that great river. The reaction across the ocean was much more interesting. Initially there, they sort of bit on the idea of a consortium—the talks reached an apogee during Nazarbayev's visit to Washington. But then they rather rapidly came to nothing. Especially when people in the United States began talking about the unsuitability of Baykonur and its infrastructure for Western space hardware, not to mention the Western hardware specialists.

But Nursultan Abishevich achieved his goal: by the time of the start of the Russian-Kazakh summit, Moscow was ready to agree to a number of Alma-Ata's conditions regarding Baykonur. For example, the term of the lease (20 years, instead of the 30 that Moscow had asked for). Or the lease payment being in hard currency (Moscow initially suggested payment in rubles, but the Kazakhs were too sophisticated to go for that). But those things didn't involve what was most important. And no one should be confused by Alma-Ata's consent—too fast, at first glance—to the amount for the lease, a paltry $115 million in all, which, in addition, is to be paid on a compensatory basis and in the context of mutual settlements between the two countries. I dare say that Baykonur, from the beginning, was regarded by Nazarbayev as a splinter in the country's side, as something that had to be removed at any price, but not without saving face. The splinter is now removed, and the face is glowing with profound, full satisfaction.

Having solved the problem of the splinter, Nazarbayev, stung by the political battles, has now immersed himself in a more customary element, advancing the idea of creating a new Union—this one, Eurasian—across the broad expanses of the former USSR. Declaring that the "euphoria of sovereignty" is now a thing of the past, Nazarbayev has concluded that the successful development of the ex-Soviet peoples is possible only on the road to consolidation in a new union—a union with one parliament, one economic and defense policy, one border, and one currency.

Curiously enough, in fighting for the well-being of the peoples, the president of Kazakhstan allowed that now all of them are worthy of joining in on the new integration ecstasy. "Less equal" were those who, to this day, pay tribute to the god of war, Mars (the Armenians, the Georgians, the Tajiks, and the Azerbaijanis). The rest, according to Nursultan Abishevich's logic, will become members of some sort of "elitist club" that doesn't care about what's happening outside its walls. He was quiet about who would be in control of the club. One can only guess that the leader of Kazakhstan would give himself one of the leading roles in the EAU [Eurasian Union]. And in fact, it's true that Nazarbayev has long sat in the backyard of the CIS, and how can it be forgotten that they didn't call him to Belovezhskaya Pushcha?

Only the lazy ones in Russia didn't take up Nazarbayev's idea, and everyone is trying to palm it off as his own (the first to do that have been those who have designs in the future on the biggest, most comfortable office in the Kremlin). The first to respond was Vladimir Shumeyko, who interpreted Nazarbayev's initiative in his own way: a new union could be created, in his opinion, on the basis of already existing institutions of the CIS, including (clearly) the Interparliamentary Assembly, which is headed by Shumeyko. And his friend and rival, Sergey Shakhray, even intends to publish on behalf of the PRES [not further expanded] in the next few days a draft of a treaty on a confederative union, the basis for which will be the "same idea that President Nazarbayev has, but written in legal language." In that, apparently, Shakhray has garnered much more experience than Nazarbayev has.

The only one who has maintained a wise silence is the one who was the first to hear the idea of a Eurasian Union, Boris Yeltsin. And judging from everything, the Kazakhstan leader was a bit discouraged by the reaction of the Russian president—or more precisely, by the absence of a reaction (it's no accident that, as he left Moscow, he kept saying that he wasn't joking and that his idea wasn't anything earth-shaking at all). The silence of the proprietor of the Kremlin lasted indecently long—until Thursday, when, through his press-secretary Kostikov, Yeltsin uttered that he "showed a guarded interest" in the creation of an EAU. The morals to the story here could be two: "The cobbler should stick to his last" and "Don't eye someone else's bread." Anyway, we'll keep going and we'll see.

Alpha Station Project Said To Serve Only U.S. Interests

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[Article by Leonard Nikishin, under the rubric "Crisis of Genre": "Russia Has Given the Astro-Vehicle to America;" first paragraph is source introduction]

[Text] **A third of a century separates us from 12 April 1961, when the first space flight was performed. Over that span of time, the world has changed in a way no one could have known, and space operations, with their broad scope, have lost their romantic aura and are being viewed today from pragmatic standpoints. But they won't have to answer to that criterion forever.**

Twenty-five years ago, the steps taken by Armstrong and Aldrin on the Moon destroyed the propaganda myth about our preeminence in space, and since a similar Soviet program (highly secret) had crumbled completely, our leaders had to quickly save face with something else.

The helping hand turned out to be excellent: an orbital station, an "outpost for man in the Universe."

They rivetted it together hastily, as we say. At that time, in the early '70s, the design bureau of Academician Vladimir Chelomey was slowly developing the Almaz manned station for military purposes (which ultimately was of no use to the military). The drawings for the structure of the living quarters had already been done. In Sergey Korolev's design bureau, those quarters were quickly filled with gear from the Soyuz spacecraft, and the Salyut-1 station was practically ready. Brezhnev, with obvious relief, announced that we were "travelling a different path, one that is step-by-step and focused," in the exploration of space.

The Americans had achieved the political objective of recovering the country's prestige, and with the end of the Apollo flights, they no longer thought about the Moon. But our fixation on orbital stations lasted decades. There was no particular mystery about it: here it turned out to be possible to have a propaganda gain, demonstrate the "power of socialism," strengthen "international friendship" in orbit, etc. Serving that aim were, primarily, the Salyuts, which followed one after the other, and, later, the Mir station. Of course, their numerous crews also performed scientific and technical research. The cosmonauts conducted observations of Earth and photographed it, they experimented with the production of new materials and biopreparations in microgravity, and space medicine garnered experience. In no way do I wish to cast aspersions on that research—but it's important to note here that the results of that research turned out not to be commensurate with the immense amount of spending for the development and operation of the orbital stations. In addition, virtually nothing was later used by the national economy.

It was Yuriy Andropov, after he became general secretary, who raised the question, "Why are they up there circling around?" At his behest, the creation of a special commission got under way; but the general secretary died soon after, and with him the things he initiated. Then, during the years of perestroyka, Yegor Ligachev got interested in the same thing, but he was soon distracted by more important matters.

That's how orbital stations came to last to this day. The cosmonauts go aloft, stay in orbit, come down, and receive their stars in the established manner. And although the political gain today is—let's put it this way—minimal, the democratic authorities haven't set out to change anything here. Foreigners have worked successfully on the stations—some for free, some for money that, for them, by and large, is insubstantial.

But the main thing is this: today, as it was two decades ago, everybody is busy. NPO Energiya, the Khrunichev Plant, the Progress Plant, the Center for Cosmonaut Training, the numerous medical professionals keeping track of the health of the celestial travellers, the space-forces officers, and—as the last general secretary said—so forth, and so forth.

That huge infrastructure operates at virtually the same tilt as in the days of the "great space victories," and it gets by on virtually just as much. And you won't find anybody who can explain clearly why this is being done. Oleg Baklanov, it's true, shared his uncommon thoughts on the pages of the newspaper DEN about the "karmic striving of Russia to the stars."

But in general, the golden days of the pioneers of space have already passed. And no matter how favorably inclined those in authority are toward it, they can no longer provide that endless flow of money. Buran, along with Energiya, had to be mothballed. They haven't managed to replace the ageing Mir with the Mir-2. And to tell the truth, the manned space flights were quietly winding down naturally. But something happened that broke the course of events.

The program for developing an orbital station in the United States has been in existence for 10 years, but its has never gotten off the drawing board. In a country with a flourishing economy, the state did not consider it possible to force expensive operations with fuzzy goals. Congress was stingy, and that's not surprising, in light of the strong criticism from the public. In fact, it's hard to consent to spending billions on something that is, as the NEW YORK TIMES put it, merely "adventures, and nothing more."

And here is where the Americans didn't so much luck out, as luck out incredibly. Russia showed up with its "karma."

An agreement was signed at the governmental level on the creation of the Alpha international orbital station with Russian participation. In fact, its proprietor will be the United States, which is giving Russia $400 million between 1994 and 1997 for its contribution to the effort.

So what would seem to be so bad about that? International cooperation in the performance of such complex, expensive projects is a sacred matter. The question is, To what extent will we be participating, and how much will we be compensated for it?

The first stage of the creation of Alpha involves the development of the large fuel/energy unit and the living unit (base unit and service unit). And, of course, the transport systems. Russia is doing all that—the Americans are limited to small units with science gear (and their expenses are cut by up to $2 billion a year). They are not rushing with their living module, leaving its development for after the year 2000.

And that's all for $400 million. By comparison, the Khrunichev Plant has concluded several contracts for launches of satellites atop the Proton rocket. The contracts are worth $600 million. The annual cost of leasing Baykonur from Kazakhstan is about $150 million.

"We're getting out of a tough spot today," Yuriy Koptev, director of the Russian Space Agency, blurted out, "and for three kopecks we're selling what it took decades to produce."

It's hard to blame the Americans—why would they pass up an intellectual product that is incredibly inexpensive and swims right into their hands? But the question is, Why are we doing it? After all, the development, manufacture, launch, station flight control, and station supply—all that goes far beyond the bounds of what is, in this case, the insignificant sum of $400 million. Everything can be explained simply: it's as hard to get extensions of that work in the context of a national program as it is easy to get money from the government for an international program. Just don't violate the agreements. It's strange that Prime Minister Chernomyrdin didn't see any of that when he was signing such an important document in the United States or when he was making substantial concessions to the Americans by restricting the transfer of cryogenic rocket-motor technologies to India.

The beginning of the operation of Alpha will be preceded by extensive operations by the Americans on the existing Russian orbital station Mir. American research equipment and gear is being installed on the Priroda and Spektr modules. Thus, the time will soon come when the station will be operated in the interests of the Americans. They will spend a total of nearly two years on Mir, and the cost of that will also come in at about $400 million; strictly speaking, that money will probably also go for support of those flights.

In general, the Mir station and all the designs adopted in the course of its development are of great interest to the Americans. In actuality, they are now completely revising it. The developers of the station's onboard systems were sent questionnaires containing 50-70 items. That unique transfer of know-how was indirectly stipulated in the contract, although in another place in the document, it said that the Mir station and the Space Shuttle (which nobody intends to acquaint us with) are national systems.

It's not hard to understand the interest displayed by the other side for our space technologies. In this country, there was a golden rain in that area; but in the United States, after the end of the Apollo program, there was never adequate government financing, private investment couldn't cover everything, and the best personnel, unlike with us, were certainly not concentrated in the space sector.

The interaction between the two sides is unique. All the joint documents, protocols, etc., are prepared by the Americans and signed in English only. At the same time, according to employees at the Russian Space Agency and NPO Energiya, the same small group of specialists went on the working visits to the United States, and they firmly attached themselves to those trips. Certainly not all of them speak or read English, and not all of the technical questions are within their competence. But they sign everything.

The scope of the work is large. The Alpha station in the final version is an entire space "settlement" with a set of national modules, although modestness here, as they say, would only be decorative. But the Americans are no longer arguing—they have removed the main burden from themselves.

But we're still operating with the same spending mechanism. One wonders when reading the decree of the Council of Ministers of the Russian Federation titled "On State Support and Supply of Space Operations in the Russian Federation." It's as if written right from the decrees of the Central Committee and the Council of Ministers of the '70s, except that they were classified. Support, permit, allocate, disseminate... The last word pertains to all sorts of privileges—the Russian Space Agency, of course, did not forget itself. There's even a markup for the tax "for classification" (it is still there, it seems). Not 15 percent, as before, but 20.

It is felt that the impending, substantial budget spending does not scare our "marketeers," who, in concerns about space matters, have suddenly become (to the joy of the intellectual opposition) "state-men." But for which state?

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